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A NEW WORK SAFETY MANAGEMENT SYSTEM IN CONSTRUCTION SITES

Construction industry is one of the branches of industry with the greatest accident hazard, and this is confirmed by the statistics of the State Labour Inspection (PIP) and the Statistical Office (GUS). The number of accidents in construction industry grows from year to year. Considering the accident figures in the construction industry, changes have to be introduced in the work safety management system immediately using modern ways. The work safety management system developed by EkoLan, a developer operating in the Tri-city of Gdańsk, Sopot and Gdynia, is an interesting solution. At EkoLan, an original work safety management system has been implemented for many years at construction sites managed by that company. The article presents and discusses both the principles of operation of the system and the results from two summers of research on the systems in practical conditions.

Keywords: E-2012 system, safety management system

1. INTRODUCTION

The construction industry, as confirmed by statistics of the State Labour Inspectorate (PIP) and the Central Statistical Office (GUS), is in a group of enterprises which most often experience accidents at work. Observing statistics in Poland and Europe, one may notice a decrease in accidents in the construction industry, while the percentage of accidents is actually huge and thus leads to implementation of considerations aimed at further reducing accidents in the construction industry. Only in the first half of 2012, 3328 [1] accidents at work were recorded, in the corresponding period in 2011 9222 cases were reported [2]. Such a state requires making immediate changes in the system of safety management, by having a modern view of the problem of accidents in the construction industry. An interesting solution is the work safety management system developed by the Tri-City Developer EKOLAN company. This system is being studied for over four years in Gdansk, Sopot, Gdynia on

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construction conducted by EKOLAN. A specific feature of this system is that while admittedly it relies substantially on assumptions of the PN-N-18001 System and OHSAS 18001, it is less formalized. The two main pillars of the system are an interactive checklist of identified hazards at EKOLAN construction sites. The second factor is awareness of management and employees of potential accident situations [3]. Shaping awareness related to work safety at construction sites is conducted in cycles of training courses and symposia and workshops.

2. WORK SAFETY MANAGEMENT SYSTEM IN CONSTRUCTION INDUSTRY

The assumptions of the work safety management system in EkoLan are based on the limitation and reduction of accidental hazards at the source. The system introduces no complicated assumptions or procedural solutions, but focuses on compliance with the requirements of Polish law, and emphasizes the continuous improvement of technical and engineering processes, and the reduction or limitation of hazards which may occur or have occurred. EkoLan's work safety management system is presented in Figure 1. For the purposes of research the safety management system was named E-2012.

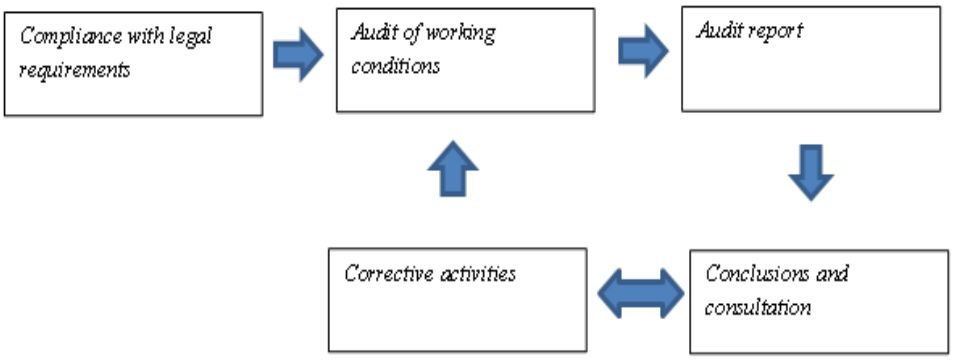

Fig. 1. E-2012 work safety management system (the author's document)

The model presented in Figure 1 resembles and refers to the work safety management system in conformity with Polish Standard PN-N-18001 and OHSAS 18001. In contradistinction to the assumptions of the standards mentioned above, the E-2012 system refers to construction industry only. The system's assumptions are as follows:

Fulfilling legal requirements: relating to the implementation of and compliance with law and rules in force in Poland, which every plant should obey, e.g. those in the Regulation on the general occupational health and safety requirements or in the Regulation on occupational health and safety at construction sites, or the creation of the Health and Safety Plan (the HSP).

The audit of work conditions: Polish law on occupational health and safety requires the review of working conditions at a plant at least once a year, that being the minimum requirement. Such solutions work well in the case of plants with a low estimated workplace risk. In the case of construction enterprises, however, there is a need for site management and persons involved in the development of work safety in the plant to prepare a control and supervision system in which control is exercised more often. Cooperation between the management and safety staff is an indispensable element of work safety management in the E-2012 system. This is where the first similarity between the E-2012 and the requirements of PN-N-18001 or OHSAS 18001 can be seen. The assumptions to the E-2012 include site safety audits depending on the level of the estimated workplace risk, whose level determines audit frequency. The audit ends with a report, which contains hazard identification and an assessment of the degree of damage severity. The E-2012 provides for only two degrees: a "minor" and a "serious" hazard. Such an approach never makes a mistake and an incorrect classification of a risk level is impossible and thus enables even a person with limited experience to assess the implications of a hazard in a reliable way. A sample audit report is shown on the Figure 2.

Occupational work safety audit **0… /…..**

Capital project: **EKOLAN S.A. Site ……** Date: ……

1. Scope of inspection:

……

2. Scope of works being performed at the site:

Buildings and civil structures

No.	Building	Construction stage	Number of apartments / parking spaces
1			
3	The site		

3. List of hazards

List of hazard investigation results

No.	Name of a hazard	Occupation	Company	Serious	Minor
1					
			TOTAL:		

Summary schedule of hazards

Hazard	Total
Serious	
Minor	

4. The following was found during the inspection:

……

5. Photos of the hazards and incidents violating occupational health and safety principles and provisions of law.

……

6. Conclusions and recommendations

……

7. Comments

Signature of a person performing the audit

Fig. 2. Sample report of the inspection of site work condition
(based on Ekolan's in-house source documents)

To make hazard identification and the correct classification at the plant easier, the recommended list has been developed, in which hazards occurring at sites were included and divided into minor and serious. The list is interactive and is updated and completed with new hazards from time to time. The hazard level is qualified based on the list. A hazard assessed as "serious" may result in the immediate suspension of the work or in penalties provided for in agreements with contractors and subcontractors. Hazard identification as "serious" does not always end with work suspension or with a penalty, but may also result in the elimination of that hazard immediately. Serious hazards include situations whose consequences may cause serious bodily harm or death of an employee. All other hazards are minor. The system adopts the "no hazard classification change" principle, that is, even if a hazard is recurring but was classified as minor, it always remains at the level of its original classification, despite the frequency. The classification of hazards on the recommended list ensures in practice that the minor hazard will not turn into a serious one. Figure 3 shows the distribution of "minor" and "serious" hazards at the construction site as identified during the operation of the E-2012 system.

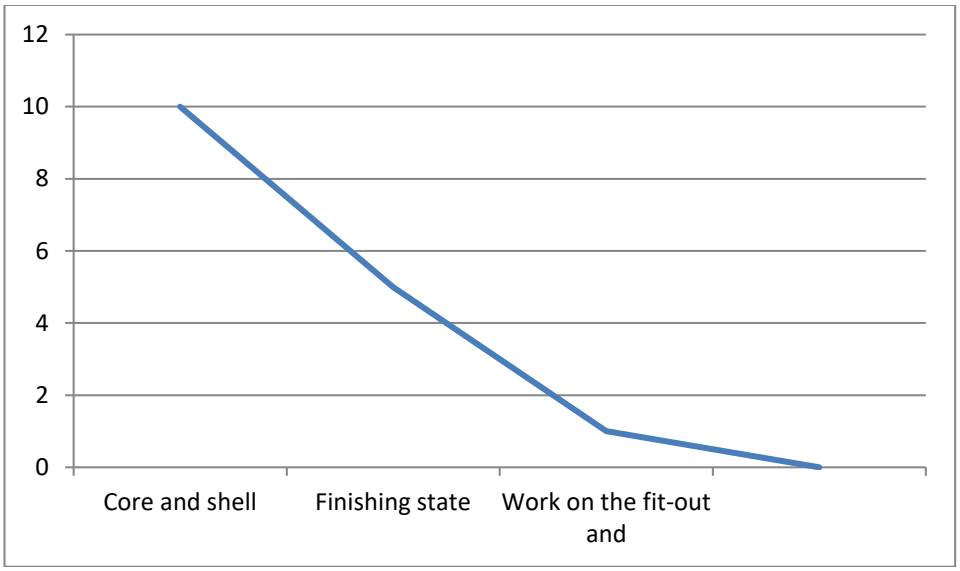

Fig. 3. Distribution of the identified hazards at the construction site (the author's document)

The recommended list of hazards is an interactive list, which should be changed and updated (depending on the needs and stages of the works). The audit and hazard classification rules must be taken in mind.

The rules in force in the E-2012 system:

Two kinds of hazards are considered: "minor" and "serious." A hazard is serious if its occurrence may cause serious bodily harm or death to the employee. Hazards are classified directly at a construction site based on the recommended list and subjective assessment by a specialist in occupational health and safety. Hazard classification is indisputable and it is not cancelled if the hazard is eliminated. The recommended list is an interactive list, which is updated from time to time. Safety checks are performed at the site regularly, at least once a week. As a minimum, one control report per month is drawn up, based on which a report of risk factors is prepared for the site. Audit reports are submitted by the site manager. The site manager develops monthly and annual safety indices and presents them to the Management Board. The main assumption is to minimise the required documentation and focus directly on work safety at the site. Greater emphasis is laid on preventive action and on elimination of hazards at the source directly at the site. The E-2012 system considers work safety management as a project. The system determines the duration of the project, which may take a maximum of one calendar year, and divides the works into stages. The system considers only two stages at which the works can be carried out, namely the stages described in construction industry as the core and shell, and the finishing stage.

The core and shell [1]: this stage came ***into being*** through the combination of the following stages of the works: the building substructure, the open core and shell and the closed core and shell. That means that the E-2012 describes the core and shell as the stage at which the foundations and basement of the building, if any, the ground floor slab, all floors and roof are built and first fix joinery installed. All the works relating to earth works and systems outside the building are included as well.

The finishing stage [1]: the stage at which all the systems relating to the building are made in it, and its appearance improved, e.g. rendering, floor toppings etc. are made until the building is prepared for use.

While the project perspective on the work safety management system permits more effective identification and elimination of hazards, action directly targeted at the source of hazards, at the construction site and at the division of the works into stages, enables a quicker reaction to accident situations and prediction of certain hazards. That the E-2012 may be successfully implemented in small and large construction enterprises is an additional asset of the project perspective offered by that work safety management system. In the case of PN-N-18001 and OHSAS 18001 systems, their implementation and subsequent functioning in small construction enterprises is not always cost-effective. The project perspective supported by the E-2012 is considerably cheaper and requires no additional staff. It is also possible to outsource audits, which also reduces the costs related to system functioning.

The assumption taken by EkoLan is a minimum of one audit per week conducted at sites by a safety officer. Two audits in a month are ended with reports submitted to the manager, who uses them to develop a monthly safety index (to assess workplace risk). The next two audits, during which hazards are obviously identified, are advisory in character. Audit reports are not prepared but comments and recommendations are made. Checks are not announced in advance and site managers learn about them on the safety specialist's arrival at the site. Unannounced checks enable the assessment of the actual occupational health and safety conditions. The system does not require additional implementation activities. A decision on the operation of the system is taken and relevant information passed on to the employees and subcontractors by the Management Board. Even if the subcontractors do not have any work safety management systems in their organisations, they are able to accept the rules of the E-2012 without additional costs. Each subcontractor working at sites is informed about the system in force and obliged to comply with the rules. This does not require additional agreements or undertakings, but only a relevant wording in the agreement between the investor and contractor. There are no "conflicts" with enterprises which have implemented a work safety management system. In addition, each of the site managers at EkoLan checks the work safety conditions every day. Those activities complete and support the system thus eliminating near-misses and reducing accident figures. The results of research conducted for more than two years with the E-2012 system at sites in Gdańsk, Gdynia and Sopot indicate that the system operates effectively and orient further action aiming at its improvement. The main advantages

of the system include the simple structure and principles as well as the project perspective, the latter enabling a flexible and dynamic reaction to changes occurring in the course of the works. The simple structure also enables the quick implementation of the system rules in those organisations which do not have any systems and perform works at the site for a longer or very short time. Examples include inspection bodies such as the State Labour Inspection and the Construction Supervision Authority. Such a visit may be paid suddenly and without a previous notice, but the E-2012 takes that situation into account and accommodates itself to the current situation. A similar situation occurs in the case of prospective customers or bank representatives etc. A majority of those persons may be at the site for the first time, and they may not be fully aware of the hazards. Following training or induction, which is a legal requirement, such a person receives information about the system and rules in force as early as during such training. The system treats all the persons staying at the site as "employees." Research permitted the identification of those stages of the works, at which the greatest hazards occur.

EkoLan performs annual settlements and a safety management project takes one year. On completion of the project, the indices are analysed and new needs and objectives formulated depending on the final figures. System modifications are allowed for during practical activities. Table 1 shows the schedule and division of the identified hazards in the first six months of 2012.

Table 1. Schedule and division of the identified hazards in the first six months of 2012 (the author's document)

Month	**I**	**II**	**III**	**IV**	**V**	**VI**	**Total**
Minor	24	10	9	18	10	24	95
Serious	2	2	1	0	2	1	8

Table 2. The recommended interactive list in Ekolan's system (on the basis of Ekolan's in-house source documents)

No.	**Name of hazard**	**Yes**	**Comments**
	Serious		
1.	Lack of permanent protection against falling from a height greater that the 1st floor		
2.	Incomplete barriers on floor slabs above the 1st floor; more than 0.7 m length		
3.	Lack of protection at the balcony		
4.	Soil arisings directly next to the excavation edge		
5.	An employee under the influence of alcohol or drugs		

6.	Lack of the protection of the limiting outline at a 2 m section		
7.	Lack of the protection of an opening greater than 0.3 x 0.3 m in floor slabs		
8.	Lack of barriers by the stairs and in staircases		
9.	Lack of crane working zone marking		
10.	Lack of protection on a roof hatch		
11.	Lack of the protection of a limiting outline during masonry works above the 1st floor		
12.	Bad technical condition of scaffolding (based on a visual check); the lack of acceptance reports		
13.	Lack of traffic route marking (for vehicles and pedestrians)		
14.	Lack of the Health and Safety Plan		
15.	Lack of the protection of a limiting outline over ca. 50% of the circumference		
16.	Sloping roof – the lack of a safety harness and hard hats		
17.	Unprotected opening in a lift shaft		
18.	Lack of protection at the edge over the length of 3 m above the 1st floor		
19.	Lack of the occupational risk assessment at the site		
20.	Lack of safety instructions		
21.	Lack of regular checks and measurements of temporary electrical works at the site		
22.	Employees without current licences and medical examination and safety training certificates		
23.	Unprotected walls of an excavation more than 0.9 m deep		
24.	Lack of safety barriers on roof edges		
25.	Lack of a slope over 4 m in a wide excavation		
Minor			
26.	Cutting by means of a sawing machine without safety goggles		
27.	Lack of a canopy above an entrance to the building or the lack of the required canopy inclination angle of 45 degrees		
28.	Lack of an operation zone marking for a digger, pumps and concrete mixer trucks		
29.	Lack of intermediate barriers and toe boards in scaffolding		
30.	Lack of data on loads on scaffolding platforms		
31.	Work on the roof / at heights without hard hats		
32.	Lack of up-to-date inspections of scaffolding		
33.	Lack of scaffolding resistance measurements		
34.	Lack of the protection of door openings on the ground and 1st floor		
35.	A gap greater than 2 mm between the wedge and tooth on a sawing machine		
36.	Hole cutting without safety goggles		

37.	Lack of toe boards at floor slab edges etc.		
38.	Insulation on conductors, extension cord power strip, cables etc.		
39.	Lack of protection against a fall from 1.0 m in a staircase		
40.	Flattened "head" of a chisel or another tool		
41.	One gate at the site, no separation of pedestrian traffic		
42.	Lack of a canopy above a sawing machine		
43.	Lack of fence around a deep excavation (over 1 m deep)		
44.	Compaction jobs without hearing protectors		
45.	A walk-down footbridge inclined at more than 30 degrees		
46.	A damaged ladder		
47.	A mess and disorder in the building and flats		
48.	A mess and disorder at the site		
49.	An angle grinder without a shield		
50.	Lack of protection by a 1.5 m high winder		
51.	Employees without hard hats outside the crane operation zone		
52.	Lack of a safety harness during window fitting at the ground floor		
53.	A 3.0 m high slope inclined at 70 degrees		
54.	A nailed-rung ladder		
55.	Lack of an intermediate barrier and toe board		
56.	Moving safety barrier by the stairs		
57.	Acetylene cylinders lying on the ground		
58.	Open distribution boards, with solid shutters		
59.	A ladder leading to a higher level ending at the floor slab level		
60.	Lack of protection of an opening up to 0.3 x 0.3 m		
61.	Lack of a danger zone during works at height		
62.	Lack of protection over a section up to 2.5 m to the 1st floor		
63.	Lack of intermediate barriers in a compartment		
64.	An extension cord without grounding pins		

Table 2 presented above is interactive; new hazards are added or the recommended hazards updated depending on the actual situation at EkoLan sites. The list is updated following consultation with the Management Board and site and project managers.

3. CONCLUSIONS

The hazards on the list are assessed on two levels, namely as minor and serious, and the risk relating to work at the site at three levels: small, average and high, within the range from 1 to 10, where 1 is the lowest value meaning a small risk, and 10 the value meaning a high risk.

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ZARZĄDZANIE BEZPIECZEŃSTWEM PRACY W PRZEDSIĘBIORSTWIE BUDOWLANYM

Streszczenie

Artykuł przedstawia nowatorski sposób zarządzania bezpieczeństwem pracy opracowany i wdrożony przez trójmiejskie przedsiębiorstwo deweloperskie Ekolan. Prezentowany model zarządzania został opracowany i wdrażany na budowach prowadzonych przez firmę Ekolan na terenie trójmiasta. Model oparty jest na założeniach Polskiej Normy PN-N-18001 z tą różnicą, że prezentowany model zarządzania jest mniej sformalizowany. Założenia systemu oparte są w głównej mierze na realizacji wymagań prawnych i identyfikowaniu zagrożeń u źródła oraz szybkiego reagowania na zidentyfikowane zagrożenia i jego eliminacja lub ograniczenie. Rdzeniem całego systemu jest interaktywna lista zagrożeń w oparciu o którą prowadzone są audyty na budowie oraz przeprowadza się kwalifikację zagrożeń.