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Risk analysis of asbestos structures and their impact on the internal environment of buildings

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Abstract. Asbestos products were abundantly used in the civil engineering in 70's and 80's. In some objects they still persist till nowadays namely in office and school buildings where they represent a health risk for people who stay in such premises on a long-term basis. These products have very often negative impacts on health of users of such premises. They negatively influence the internal environment of buildings and its hygienic aspects. One of the possible ways of risk rate evaluation of these aspects on man is using the application of risk analysis.

Introduction

Asbestos is a mineral from group of silicates. In nature it is found in two main forms as serpentines and amphiboles. All the asbestos minerals have fibrous structure with tendencies to sliver longitudinally. In the past this material was used very often in civil engineering for its good thermal insulating and mechanical properties, resistance to fire, strength and resistance to acids and alkalis. Up to the present day it occurs mainly in some buildings in roofing and flooring, water and exit pipes, wiring and in particular in form of light asbestos cement partition walls in office buildings where represents a health danger for the working staff. [1, 2]

Asbestos action at human organism

The long asbestos fibres enter in human bodies together with the inhaled air. They are able to get even to the air sacks where they can invoke a local reaction which could result in disease formation. The health problems may start in time when the affected person has not been working with asbestos for years. The people who worked with asbestos on a long-term basis, must be medically controlled regularly and stay under the medical control for rest of their life.

The asbestos may cause lung cancer and other serious lung diseases like for example the pleura fibrous changes; tumour diseases of the pleura (it can be initiated even after 50 years from the first contact with the asbestos); asbestosis – gradual substitution of lung tissue with fibrous tissue.

In EU countries it has been prohibited to market any products containing asbestos since 2005 (in the Czech Republic since 1997). However namely in Russia, China and Canada the asbestos mining still grows. The world asbestos production is about 2, 3 million tons per year. [1, 2, 3 and 4]

Removal of asbestos

Due to the big health risk which asbestos products represent, they must be removed and substituted with asbestos-free materials.

Removal of the asbestos must be carried out very carefully by an expert company in a way that no significant release of asbestos fibres into surrounding environment happens; subsequently the company must also provide a safe liquidation of formed asbestos waste. The staff working with this material must use the set working protective equipment.

1) analysis of asbestos presence in the building is carried out;
2) the intention shall be discussed with particular surveyor's office (notification, building control – provision of relevant documentation);
3) around the place of future remediation works a so called control area shall be established which will be made from boards and reinforced foil, sealed with PURR foam and band. In this way the spread of asbestos fibres to the surrounding area is prevented during the works;


Fig. 1, 2: Controlled area for handling with asbestos products [2]

4) material stabilisation shall be made and the material will be removed in a special regime which prevents scattering of asbestos fibres - moistening of dismantled materials with water or the asbestos materials are sprayed with polymer materials before the dismantling;
5) the area is decontaminated;
6) measurement of occurrence of asbestos fibres will be provided in the area after decontamination. Only independent accredited laboratory may perform the measurement. The limit set by the MHZ Regulation no. 6/2003 is 1000 fibres/3^{M} for internal environment of selected stay rooms;
7) waste liquidation – the wastes with asbestos content can be removed only in the equipment and upon the conditions set according to § 35 of the Waste Act no. 185/2001 and other related regulations. [1, 2, 3 and 4]

Fig. 3: Safe liquidation of asbestos waste [2]

Application of risk analysis on constructions made from asbestos

The universal matrix of risk analysis shall be used at evaluation of status of the light partition walls in the office building interior. The partition walls are asbestos-cement ones and approximately 30 years old, their surface is damaged at some spots. The four-member expert team led by expert analyst assessed the condition of internal partition walls and the risk, they represent for employees. [5]

Table 1: Severity level scale

Evaluation of construction condition	**Characteristics of the conditions and wear and tear of the construction**	**Severity level V_s.**
Excellent condition	the construction is in the excellent condition without any signs of any considerable wear and tear	1
Preserved	the construction is preserved with visible signs of ageing , however it still performs its function	2
Damaged	the construction with visible signs of damage, repairable, requiring stronger maintenance	3
Repair necessary	the construction urgently requires necessary radial intervention (repair)	4

To express the setting of damage we shall use the linear function which in dependence on severity level grade will be able to produce the financial value C_{hi}. A danger is perceived within 0% to 100% as a construction completely safe or completely dangerous on the contrary. In case of more experts we obtain the final value by arithmetic mean. [5]

Table 2: Form for evaluation of part of the object

Project	**Office building – internal partition walls**		
Segments of the project	Sources of danger		
	Mechanical wear and tear	Material	Cracks
Expert no.1			
Walled partition walls	3	3	4
Asbestos-cement partition walls	3	4	-
Expert no.2			
Walled partition walls	2	2	3
Asbestos-cement partition walls	3	4	2
Expert no.3			
Walled partition walls	3	3	4
Asbestos-cement partition walls	2	4	2
Expert no.4			
Walled partition walls	3	3	4
Asbestos-cement partition walls	3	4	-

Demonstration of calculation of danger perception coefficient by expert no's

Σ_{ijCijk}=20; n_{act} = 5; Ø 20/5= 4; S_{vmax} = 4;

Σ_{ijCijk} is summary of values of active;

n_{act} is number of active;

S_{max} is maximal values of danger.

$$P_{ck} = \frac{\sum S_v}{S_{v\max} \times n_{act}} \times 100 \quad (1)$$

Where: P_{ck} is the individual coefficient of danger perception;

ΣS_v is summary of active windows values;

S_{vmax} is maximum value of the level;

n_{act} is number of active windows.

Individual coefficient of danger perception we shall get by filling in the formula (1):

$$P_{ck} = \frac{20}{4 \times 5} \times 100 \Rightarrow \underline{\underline{P_{ck} = 100\%}}$$

Table 3: Coefficients of danger perception

Value	Team	Expert			
		1	2	3	4
Summary Sv^E	71	20	16	18	17
Active cell number	22	5	6	6	5
P_{ck}	81.68%	100%	66.70%	75%	85%

The mean value of individual coefficient of danger perception is set as arithmetic mean of partial values of individual coefficient of danger perception by individual experts of the team.

$$P_{ck,tým} = \frac{81.68 + 100 + 66.7 + 75 + 85}{4} \Rightarrow \underline{\underline{P_{ck} = 81.68\%}}$$

Summary

Using the universal matrix of risk analysis the expert team evaluated the condition of the internal partition walls as very unsuitable requiring a repair. The danger perception coefficient of the whole team is 81.68%. In this case the necessary exchange of asbestos-cement partition walls for other materials not harmful for health is essential.
If the reconstruction is not performed the indoor environment conditions will not be improved and users of the object remain exposed to dangerous effects of the asbestos. The users are endangered by serious health damage which can result even in death.

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Reference

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