MODELLING METHODS OF BUILDING PROCESS

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ABSTRACT

Investigation the modeling of the mathematical model of expediency of project decisions of building materials including the human safety the asbestos. The asbestos is most widely used in the production of roof cover-slate. At this moment the building materials in which composition the asbestos is used, become the actual ecological and economical problem of the country. There is created the economical mathematical model there were modeled various building processes of work with the asbestos, the alternative variants of those processes by estimating quantitatively the building processes and the amount of the asbestos must be reduced up to the minimum. Applying this solution of mathematical modeling and optimization to the real building process was created a plane of means for avoiding of a harmful influence of the asbestos to the human organism.

INTROCTION

At this moment there are used a lot of new building materials and decisions of their technologies of production in buildings of Lithuania. There are increasing architectural and construction requirements to the produced products at the same time and for building constructions. Modeling of project decisions takes the particularly important place in the building of objects. By the modeling of project decisions the attention is paid not only to the abundance of various parameters of building processes but also to the influence of those using building decisions on the human safety. Constructions must be designed and built so that there would be made all necessary conditions to feel safely in this surrounding of the utilities in which people live, work and take a rest. Although the self-feeling is a subjective sensation appearing from changing of air temperature, humidity, circulation of air, air consistency, its pressure, noise of inside and outside of utilities inside, used building materials and constructions, that is why it is necessary to estimate the expediency of usage of project decisions of construction process. In this article we investigation the modeling of the mathematical model of expediency of project decisions of building materials including the asbestos.

METHODS

Developing the industry of building materials in Lithuania, it was produced a wide range of building materials, including and those, having the asbestos in their composition. At this moment the building materials in which composition the asbestos is used, become the actual ecological and economical problem of the country. Till 1998 building materials of Lithuania having the asbestos in their composition were used without any restrictions. In 1976 International Cancer Examination Agency (IARC) declared the first time officially that dusts of the asbestos of all kinds (they have separating little fibers observed by the microscope, that get into lungs on the form of dusts) are dangerous to the health. Further separating little asbestos fibres reduce the flexibility of lungs, as the result of it the volume of lungs decreases and it could rise the cancer illness of respiratory. In Lithuania registered case of death from the illness of lung cancer due to the asbestosis there are shown in Figure 1.

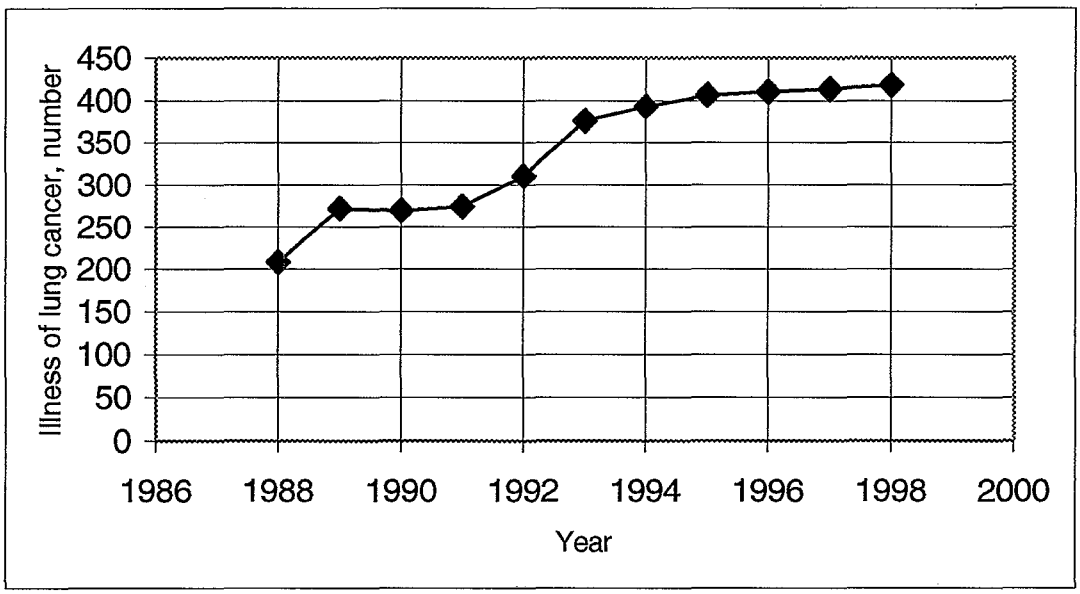


Figure 1.The death from the illness of lung cancer due to the asbestosis in period 1988-1998

At this moment producing the roof covers there are looking for substitutes to the traditional asbestos. Despite it, the slates, including the asbestos, cover almost all constructions of village, roofs of buildings in small towns and district centers. Besides the asbestos is widely used in the works of pipe isolation, the production of automobile brake shoes, the isolation of automobile bottom, etc.

The asbestos is most widely used in the production of roof cover – slate. (Figure 2). Only in 1996 it was used 5000 tons.

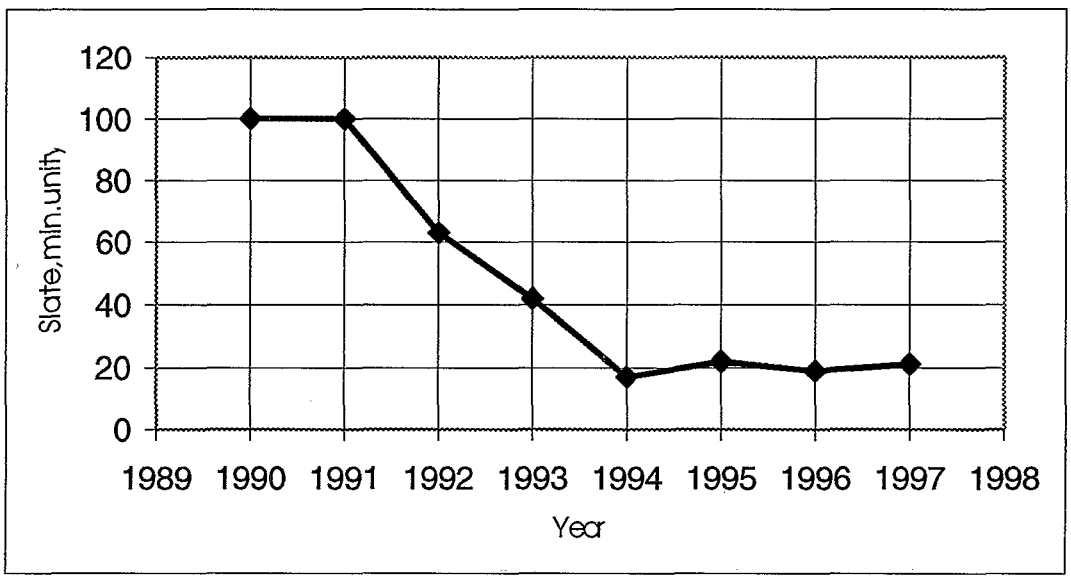


Figure 2. Slate including asbestos dynamic of production in period 1990-1997

The production of this building material is not only unhealthy, but also it requires a lot of expenditures of fuel. In eight decade in a lot of Western countries the asbestos fibre was not yet prohibited, but the producers of building materials felt the constantly growing pressure of

society and some politic and profession groups ("green peace", doctors, profession alliances) to refuse the asbestos. Due to the fact that through the short time period it is impossible to refuse the asbestos at all, there was chosen a tactic of compromise stepped restrictions. At first it was forbidden to use the type of asbestos known as the most dangerous. Later restricting and forbidding the usage of building materials, those include the asbestos, in living and public buildings. It was forbidden at all to use such building materials from which the asbestos dusts can comparably come off. Such materials – are the covers of fire-prevention, sound isolation and thermoisolation sprayed on various barriers, the plaster from the scattered asbestos and etc. It was determined that the asbestos dusts had come off mostly from them. Knowing that this material still is used and produced in our country, we offer to execute these main requirements:

- producing the building products, the amount of the asbestos must be reduced up to the minimum;
- to use the asbestos only in those cases when there is no real opportunity to change it by other building materials;
- executing the building processes in which the asbestos is used, to organize all works in the order that as less as possible of the asbestos dusts would rise up to the air;
- successfully to eliminate according the systematical approach all precipitated dusts of the asbestos out of the utilities by the help of well organized pumping ventilation;
- transporting and keeping the raw materials of the asbestos, it must be packed hermetically and kept well protected;
- it is necessary to pick up all waste with the asbestos of building materials after the work, to pack it and note by the stickers that there is an asbestos;
- performing the work of building reconstruction, that in building process will be performed with the products of the asbestos, it must be construct a strict project of work execution with clearly determined zones of work with the asbestos, instructing about it the employees.

In our country it would be necessary to follow by the "Asbestos rules" that are accepted and used. Preparing Lithuania to enter to the European Union it would be necessary to follow the Directives of the European Union accepted in 1980 – 1983. They define comprehensively the order related with the usage of chemical, physical and biological materials at work. In the Appendix 1 of 100^{th} article of the Directives there are defined the rules of work with the asbestos materials. We discuss the building process of work with the asbestos as a complex building process what can be modeled by various methods of work performing and organization, what differ only by the technology and organization of work performing. Every method differs by itself and it was characterized by certain technical or only technical – economical requirements, by estimating the corresponding restrictions and requirements.

Lithuanian building firms, not modeling the processes of building and at the same time not adjusting them, offer to apply various systems of technology and work execution, not paying attention on the most factors, that decide an effective selection of decision of work with the asbestos. At this moment the tasks calculating the motion of performing of building process are quite complex, because by selecting the variant of work execution in any stage of decision, this decision is influenced by a great variety of parameters and restrictions related between each other and influencing each other. The analysis of acceptance of various decisions shows that it could be more such the dependencies. New offering decisions must be well based economically, that is why to execute the effective processes of work with the asbestos there are applied the methods of mathematical optimization and modeling. It is necessary to note that economical mathematical modeling and optimization of these building processes have some certain structural elements, their logic feed backs and execution course.

Calculating these tasks there were modeled various building processes of work with the asbestos and the alternative variants of those processes by estimating quantitatively the course of execution, changing tendencies and dynamic of adjusting of building processes. It is constructed the mathematical model that includes the systems of conditions and the purpose function.

Purpose function:

$$Z = \min_{x_1 \ldots x_n} \sum_{j}^{n} c_j \cdot x_j \tag{1}$$

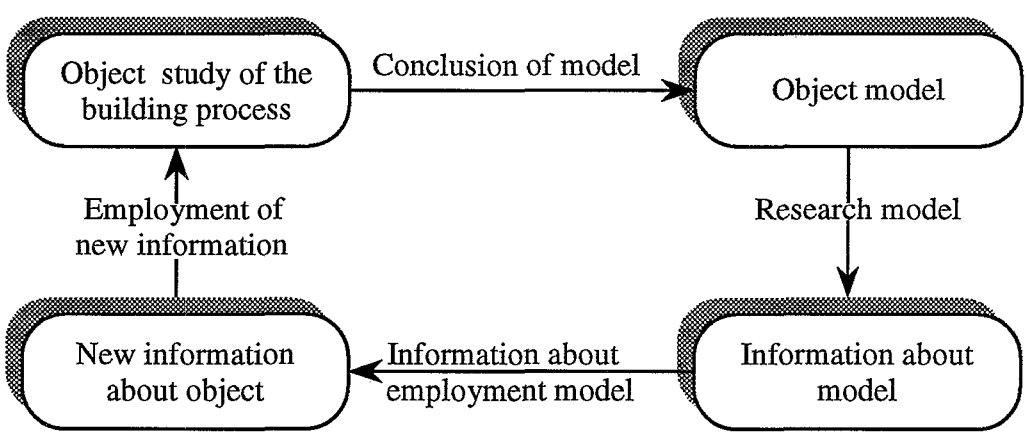
Systems of conditions:

$$\sum_{j=1}^{n} a_{ij} x_j \le b_i, \text{ here } i = 1,2,\ldots,m; \tag{2}$$

$$x_j \ge 0, \quad \text{here } j = 1,2,\ldots,n. \tag{3}$$

where c_j is the price of alternative variants, x_j is the alternative variants with the asbestos, a_{ij} is the number of the resources, b_i is the requirement of alternative variants.

The conditions rise up a lot of possible variants of execution of building process. The purpose function enables to recognize one from the variants of this process as the best. Adjusting of different systems of building process helps to receive additional knowledge of the regularity of technological processes.The structural modeling system of building process is shown in Picture 3.



Picture 3. Scheme of the structural modeling system of building process

The mathematical models of building process is constructed by the mathematical means and determining the relations of parameters of an investigative expression. As the relations are more exact, and the input parameters better define the expression, then the model more exact describes an investigative object. It is necessary to note that modeling a certain process of building, there is dissociating from the less important factors, and there are investigating only the main reasons of the investigative expression. Investigating the building process, it is constructed not only the mathematical model, but together it is calculated the mathematical tasks also by determining additional relations of different parameters and their quantitative expressions. Calculation result compared with observation data shows the reliability and accuracy of the model of this building process. If the different between the result of

calculations of mathematical model and the data observation appear, then the mathematical model has to be more expedient.

RESULTS

There is created the economical mathematical model for building works of execution and organization of building process by using a building material – the asbestos. The model was created very strictly without any logical contradiction, and evaluating all the most important factories influencing the results of investigative building process. Applying this solution of mathematical modeling and optimization to the real building process – work with the asbestos – there was created an algorithm of organizational and technological decision. Results of calculation showed that an application of mathematical models in the building processes for avoiding of a harmful influence of the asbestos to the human organism must include these means: - working inside the building the pumping ventilation is necessary – pumps with filters;

- in the zone of entering to the utility – equipment of sluices;
- all employees must wear special clothes and special work means, what must be cleaned after work;
- existing roof slate – asbestos covers on the first order to cover by special paints chemically binding the asbestos;
- performing the works of reconstruction and changing the slate – asbestos roof by new, the waste of slate are utilized in the special dumps;
- in the nearest future it is planing to use and produce only the building materials the asbestos free in the building.

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