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THE THEORY OF PROBABILITIES METHODS IN THE SCENARIO SIMULATION OF BUILDINGS AND CONSTRUCTION OPERATION

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ABSTRACT

The article deals scenario modeling like an effective way to assess design solutions for engineering systems of buildings and structures. It gives an idea about the behavior of the object in different operation modes, normal and emergency situations, typical and extreme conditions. Under the scenarios here is a set of disturbing influences of the external environment and control actions on the part of a person corresponding to the different situations and modes: design mode, fire, earthquake, extreme cold, etc.
Keywords: energy and environmental modeling; power efficient buildings and structures; software; energy-dependent systems; energy interrelations.

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INTRODUCTION

Scenario modeling is an effective way to assess design solutions for engineering systems of buildings and structures. It gives an idea about the behavior of the object in different operation modes, normal and emergency situations, typical and extreme conditions. Under the scenarios here is a set of disturbing influences of the external environment and control actions on the part of a person corresponding to the different situations and modes: design mode, fire, earthquake, extreme cold, etc [1-6].

The only effective way to organize scenario simulation modes of engineering buildings and structures systems operation is a computer simulation. It allows doing high-precision large amounts of data manipulation for a limited time. You must select the mathematical description device for making a computer mathematical model of the scenario. Take into account the characteristics of the simulated processes, such as random nature of the occurrence of certain impacts, the likely error in evaluating the effects of specific perturbations on the system as a whole, the correct method of describing such scenarios is presented a method that includes elements of probability theory, specifically the theory of mass service [7-10].

The operation of any system of mass service consists of performing inflowing requirements or applications stream. Requests are coming one after another in some overall random time Service applications continues for some time, after which the channel is released and is again ready for receiving the next request. Each queueing system, depending on the number of channels and their performance, has a bandwidth that allows more or less successfully coping with the applications inflowing.

In the case of engineering buildings and structures systems operation simulation, mean by applications the impact of various factors on the object, and mean by maintenance - engineering systems to influences' response.

METHOD

The response of engineering systems at the factors' flow described each scenario in the Theory of mass service terms is represented as a random process with a countable set of status and continuous time.

At the same time, the scenario of external influences is a stream of events, i.e. the sequence of events that occur one after the other in some moments of time. For example: the call flow at the telephone exchange, flux inclusions devices in an electrical outlet; the requests' flow to the help Desk, etc. The events forming the flow in common could be different, but here, to clarity, considered homogeneous events flow, which differ only in the occurrence moments.

From a practical point of view, it is interesting the simplest (or stationary Poisson) stream for the purposes of engineering systems' scenarios modeling. This stream of random events, satisfying the following conditions:

1. Stationary. The condition of stationary satisfies the applications' inflow, which probabilistic characteristics do not depend on time. In particular, the idea of a stationary flow characteristic constant density (the average number of requests per unit of time). In practice often the order flow, which could be considered as stationary (at least for a limited period of time). For example, a phone calls inflow in the period from 14 to 15 hours could be considered as stationary.
2. No aftereffect. This is the most essential condition for the simplest flow. It means that events occur independently of each other. For example, the elevator passengers flow that could be considered as a stream without aftereffect because the individual arrival reasons at one moment and not at another one usually are not associated with similar reasons for other passengers.
3. Ordinariness. This condition means that events occur singly, and not a pair, and so on. For example: the events flow in case of fire will be ordinary, if fires occur singly.

So, it is the simplest (or stationary Poisson) stream is of particular interest. It must be said that in practice it is usually sufficient to fold 4-5 streams to receive a stream, which can be operated as the simplest.

RESULTS AND DISCUSSION

To determine the reliability of the control system, organized by a particular structure. The classic description of the reliability of the system N_K - state probability (P). This value is determined by the formula (1)

$$P = \frac{N_K}{N_H} \quad (1)$$

where N_H - the initial number of elements of the system that is being tested; - A finite number of elements of the system remains operational. For example, the formula for determining the probability of trouble-free operation of the system with a decentralized structure will have the form (2).

$$P(t) = 1 - \prod_{i=1}^{m}(1 - P_i) \quad (2)$$

Thus, we can determine the probability of failure of the control system having any of the structures. However, considering the characteristics of reliability is not acceptable for a final decision on the choice of a particular structure of the control system, since it does not take into account the degree of criticality of various engineering systems.

It is a question that different types of buildings are critical for the sustenance of various engineering systems. Consequently, in various types of buildings should ensure the reliability of the primary control systems critical engineering systems for this particular building.

Consider this heterogeneity of the effect of various engineering systems on the viability of the building is possible by the introduction of the abstract characteristics of reliability of automatic control systems (N), the calculation of which the probability of failure of control systems of different engineering systems (P) will be multiplied by the weighting coefficients corresponding to the criticality of systems engineering.

$$N = 1 - \prod_{i=1}^{m}(1 - k_i \cdot P_i) \quad (3)$$

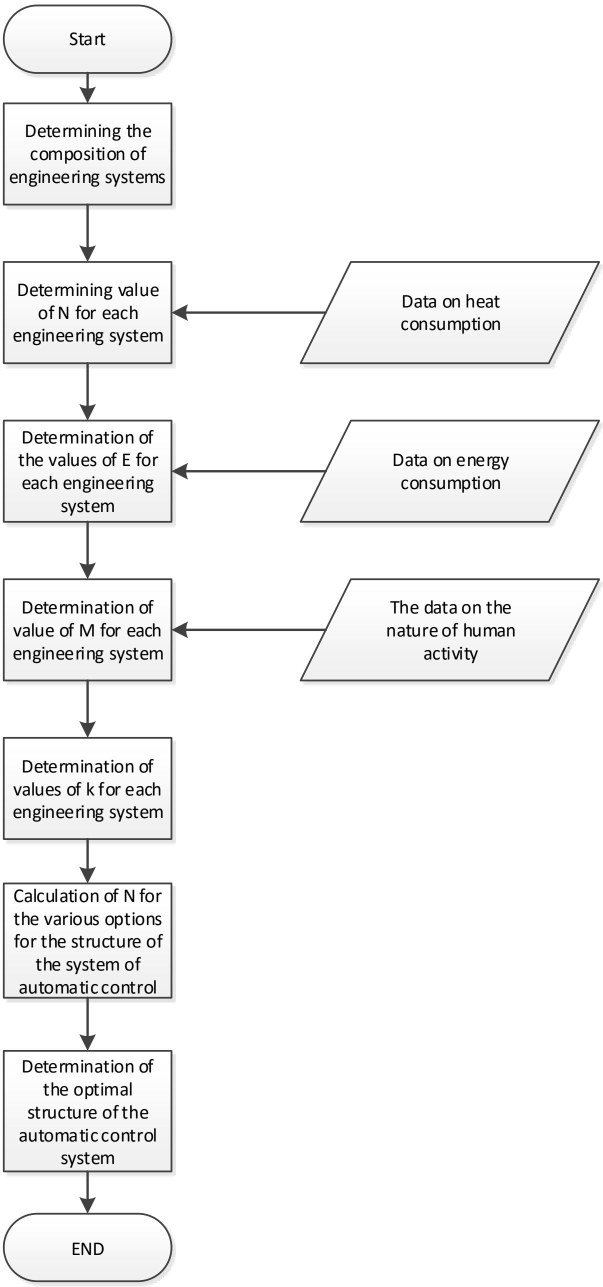
As the weighting factor for the various buildings it is advisable to use a different value. Consider the weight critical of engineering systems for office buildings.

When determining the "weight" of engineering systems of the building seems reasonable to identify three characteristics of engineering systems: the consumption of thermal energy (H, Gcal), consumption of electric energy (E, kWh), and the number of people (M), whose comfort and efficiency directly depend on the correctness work of the engineering system. Thus, the abstract weight criticality of engineering systems for office buildings can be determined by formula (4).

$$k = H \cdot E \cdot M \quad (4)$$

Thus, formalized abstract description of the reliability of automatic control systems and abstract weight critical of engineering systems. Based on the proposed response is possible to determine the optimal for this kind of building structure of the automatic control system in terms of meeting the needs of mission-critical of engineering systems.

Obviously, to assess the reliability of complex systems, building automation is necessary to make quite a significant amount of volume calculation, which is difficult and impractical to do without the use of computer-aided design. For the application of the proposed method of selecting the structure of the automatic control system in the CAD algorithm determining the abstract characteristics of reliability of automatic control system, which is shown in Picture 1.



Picture 1: The algorithm for determining the abstract characteristics of reliability of automatic control system

Application below the CAD algorithm will allow for selection of automatic control engineering systems of buildings, taking into account the degree of criticality of managed engineering systems for a specific building.

CONCLUSION

Thus, the above consideration of the engineering buildings and structures systems operation modes from the viewpoint of the theory of mass service is the most convenient for such processes computer simulation. This allows to standardize the modeling process, to use standard techniques and methods and, consequently, reduce operating time and improve efficiency assessment of engineering solutions.

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