CONTROL OF THE THERMAL STATE OF A BUILDING

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The problem of increasing the cost effectiveness of heat supply and maintaining of comfortable conditions in residential and manufacturing buildings is one of the main problems of energy saving. This problem is particularly acute for the counties with a cold winter and limited natural energetic resources, such as Ukraine.

The main way to increase energy efficiency of buildings so far was improving the heat-insulating properties of barriers. However, this way is connected with substantial reconstruction of already commissioned housing and manufacturing building stocks, as well as a significant increase in the cost of construction energy saving buildings.

Second way of increasing the energy efficiency of buildings is automation of heat supply control. Using the systems of automation of thermal capacity control allows solving the problem of maintaining the comfort conditions in heated premises in different perturbations of weather conditions [1].

The statement of the problem of building thermal condition control includes four objects: a mathematical model, a control goal, control and phase trajectories constraints and quality criteria [2].

The analysis of the features of building thermal process mathematical model is a boundary value problem of mathematical physics with internal heating sources and boundary condition of the third kind. However, it is extremely difficult to record and solve the system of thermal conductivity equations for all building elements, including external barriers, internal partitions, useful filling and internal air, which have a rather complex configuration. Besides, there are many additional issues with the assignment of boundary and initial conditions, as well as non-stationary impacts of external weather conditions and internal heating sources.

In spite of physical distribution of temperature field in the building elements, the most successful approach to implementation of the building heat control system is considering the finite-dimensional approximation of thermal processes. This is connected with the fact that the modern control theory is mainly oriented to finite-dimensional dynamical systems described by ordinary differential equations. Such a replacement of the mathematical model significantly simplifies the formulation and the solution of the control problem, but it is still connected with considerable difficulties caused by the high dimensionality of the state vector of the approximating system. The point is the components of the state vector are the air temperatures of separate premises of the building, the temperatures of the external barriers at various levels which are perpendicular to the barriers surfaces, the temperatures of the partitions between premises and the useful filling such as equipment, furniture, and so on. The enlarged structure of the mathematical model is shown in fig. 1.

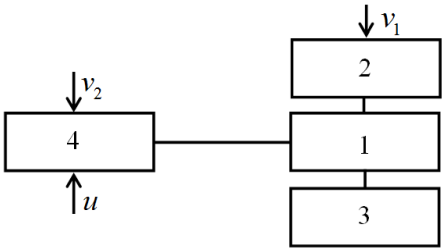

Figure 1 – Structure of the mathematical model of the heat supply process

where numeric values and parameters denote: 1 – internal air, 2 – barrier, 3 – partitions and internal equipment, 4 – heating device, v_1 – outside air temperature disturbance, v_2 – heating medium temperature disturbance, u – heating medium consumption control.

Another feature of this mathematical model is the obvious difference in pace of the accumulation of thermal energy in the barrier, the partitions and in the internal air, which predetermines the fundamental rigidity of the system of the thermal processes differential equations of the building as a whole, and, consequently, a number of complexities in numerical modeling of thermal processes [3].

As the main perturbations in the mathematical model of the heat supply process, the ambient temperature change and the deviation of the heating medium temperature from the nominal value should be considered. Except these perturbations, parametric disturbances occur in the heat supply system, which are connected with changes of the parameters of structural elements participating in the heat-mass-exchange processes of a building.

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РОЗПІЗНАВАННЯ ПОКАЗІВ ЗІ ШКАЛ СТРІЛОЧНИХ ВИМІРЮВАЛЬНИХ ПРИЛАДІВ ТА ВИЗНАЧЕННЯ ЇХ ДИНАМІЧНИХ ХАРАКТЕРИСТИК

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На сьогоднішній день серійно випускається великий різновид аналогових стрілочних приладів, які дозволяють візуально спостерігати параметри різноманітних технологічних процесів. При серійному виробництві цих приладів