The Introduction of Intelligent Prediction as the Rendering Technology Component Heat Flows

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***Abstract*—The introduction of elements of forecasting, as a part of computer-aided design systems, walling (CAD PD), to avoid problems of incorrect determination of the temperature in the design. At the design stage of the building will allow the most accurate prediction to choose thermal units and heaters to maintain optimal indoor climate, as well as improve energy efficiency of thermal points.**

***Keywords*—CAD, forecasting, visualization, heat flow, protecting designs.**

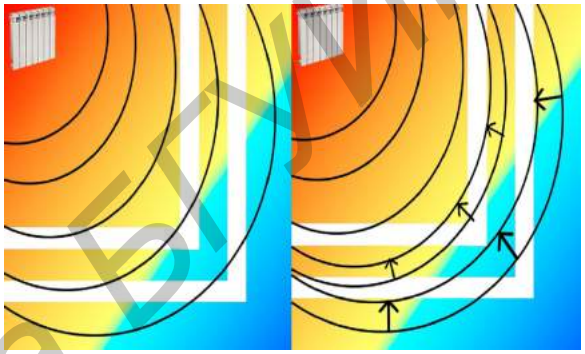

Figure 1. Visualization of the distribution of heat flows in building envelopes with intelligent forecasting components

I. Introduction

During the effect of the type of research design and sharp temperature spikes when calculating the correction value for predicting the nature of the distribution of heat fluxes on various sections of the structure were found a number of laws related to the typical error values that require additional formalized description. That description in the system are the values of the analytical calculation error compared with practical values with to collect temperature data units. [1] One of the key practical value technology developed elements is in compliance with the micro-climate and hygiene requirements [2] imposed on walling. Violation of these requirements often occurs with a sudden change in external influences, as analytical calculations from a physical point of view, they do not take into account, in other words there is no element of forecasting such surges, resulting in a breach of these rules. Consider an example when the outdoor temperature is changed to eight degrees or more for several days. Comparing the results of analytical calculations without prediction and without changing external temperature conditions and using elements based on these components to clarify the nature of the heat flow (Fig. 1.) it can be concluded on the accumulation of impermissible values of the error. The value of each of the waves from the heater to the enclosing structure corresponds to a decrease in temperature by five degrees.

The relevance of the developed system is due to a significant increase in requirements for the thermal protection of buildings, according to changes in building codes (Building regulations 02-03-79). According to the requirements of the temperature on the surface of ti enclosing structure, should be above the dew point of not less than $2 - 3^{\circ}$ C.

II. Consideration of distinctive features for building envelope components predictive forecasting

A. The main parameters of the building envelope used to predict

For the most accurate prediction of CAD PD accounted for the following design features:

- overall heat transfer coefficient;
- heat transfer coefficient of the insulation layer;
- the thickness of the insulation layer;
- one layer thickness;
- location factor;
- thermal resistance;
- values of temperatures on the inner and outer surfaces;

B. To forecast the correction coefficients

On the basis of the calculation of the value of the amendments for the implementation of the nature of heat flow distribution forecast proved violation of the rules in 2-3 C. [1], which can lead to condensation, violation of sanitary norms, reduction of design life and its thermal properties. On the basis of the calculations was proposed solution to this problem is to introduce correction factors for each selected layer. The value of the coefficients are not fixed and are directly dependent on the temperature conditions, temperature zone of the

temperature jumps forecasts based on historical data [3], the knowledge base and rules [4], and also depend on the particular layer that you want to consider as an analytical calculation method. It involves the accumulation of errors by layers.Based on the temperature data samples occurs recognition situation: the presence or absence of problem zones. The method of recognition of the situation lies in the ability to set ambient temperature conditions outside the contour, as well as granting councils in the case where the heat flux from the heater can heat the entire path.Task CAD to offer the most optimal variant layout, trace a connection point with the heat, as well as visualize the resulting heat flow from the heater and the loop of the building. The final step of the algorithm is to visualize the nature of heat flow to a specific situation in view of the identification algorithm situations and decision-making.

The result of the processing of the measuring information received from multiple sensors - recognition of options situations subsequent trace heaters. Hierarchy overlay flows represents a fusion of the two fronts - the heat from the heaters and the cold loop. The result is the total heat flow, which is then used to make decisions about repackaging heaters.Identifying situations thermal circuit eventually has only two options: no problem zones (zones freezing), or their availability.The task module CAD walling to offer the most optimal variant layout, trace a connection point with the heat, as well as visualize the resulting heat flow from the heater and the loop of the building. General Ingredients intelligent prediction visualization of thermal flows of various types with the basic parameters of the building envelope show on Fig.2.

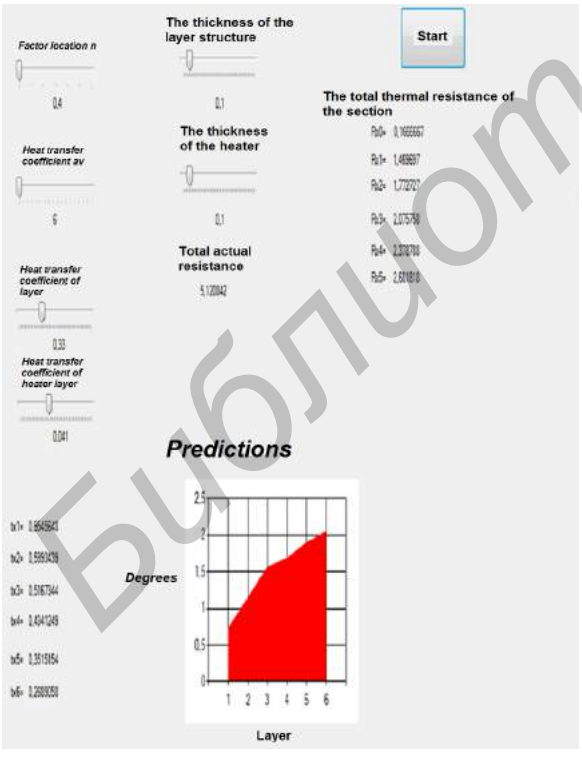

Figure 2. Core components of intelligent prediction visualization of thermal flows of various types with the basic parameters of the building envelope

Using the Intelligent forecasting the shortage of information about the nature of the distribution of heat flows, it allows you to:

1) verifying for each pick of the layers with maximum accuracy;
2) avoid the accumulation of errors in layers;
3) take into account all the parameters of the building envelope;
4) choose the type of building envelope and its properties for the design of the engineering network.

III. Example of Intelligent Prediction of Heat Flux Distribution Patterns

Consider the example of the calculation of the distribution pattern of heat flow. The temperature distribution for one of the days of the receipt on the basis of analytical calculations is shown in Figure 3.

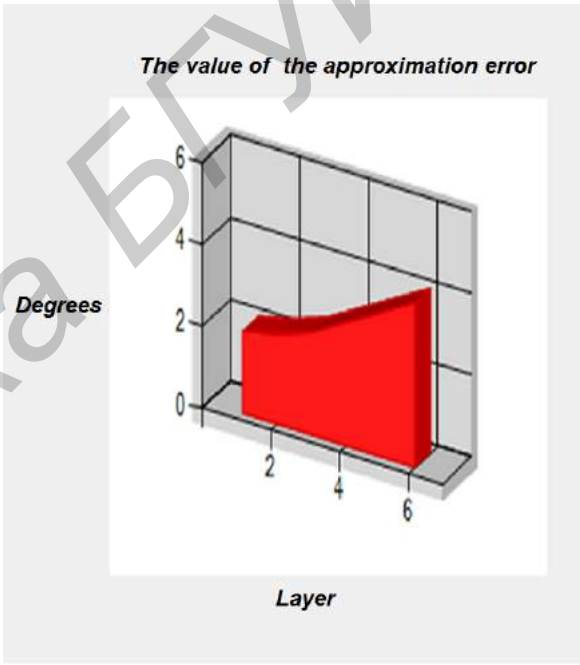

Figure 3. Analytical calculation of the temperature

Calculate the predicted values for the coefficients of the temperature distribution (Figure 4).

Thus, it is proved in violation of 2-3C., which can lead to condensation, violation of sanitary norms, reduction of design life and its thermal properties.Intelligent components of CAD allow most effectively interact with the user by means of comments.

Comments to the nature of heat flow distribution are displayed when you hover over one of the heat flows or to cross a few. They contain information that freezing problem areas have been identified and selected type of heater corresponds to the type of circuit. Comments heat flows to the zones displaying information about a particular part in the stream and provide information about the temperature of each part of the flow. Removal CAD data by using OK sensor system and the device "Terem-4" . In depending on the requirements to the thermal circuit, may also be included additional additive criteria, for example, the threshold for average energy ratio for

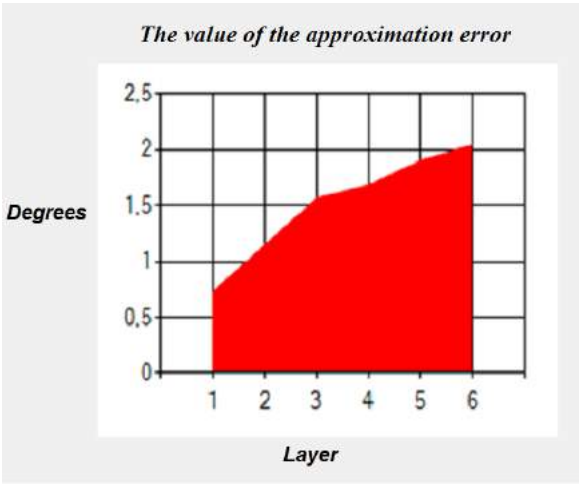

Figure 4. Prediction amendments nature of heat flow using the basic parameters of the enclosing structure

all heaters used to heat the circuit . The introduction of more stringent criteria for the comments can increase the energy efficiency of the designed circuit, however, it should be noted that not all circuits are possible to achieve the optimal limit [1].Example of intelligent prediction show on Fig.5.

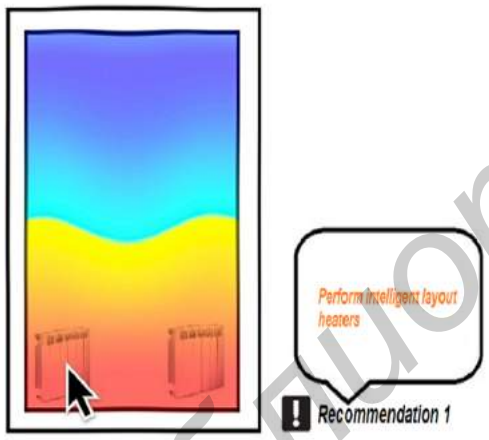

Figure 5. Example of recommendation based on intelligent prediction

IV. LAYOUT ALGORITHM BASED ON INTELLIGENT PREDICTION OF HEAT FLOWS

The task of the layout component CAD thermal utilities, to provide the most op-timal variant layout, traces a connection with the heating unit. The final step of the algorithm is to visualize the nature of heat flow to a specific situation in view of the identification algorithm situations and decision-making. The practical use of the software module using the algorithm allows using it as the design of new buildings and the reconstruction of old ones. Identifying situations thermal circuit eventually has only two options: no problem zones (zones freezing), or their avail-ability. Identify the main steps of the algorithm identifying situations and decision-making:

- Step 1. On the basis of a priori constraint matrix formed with the use of IP-linear programming techniques form the principal-WIDE intervals.;
- Step2. We form the matrix of restrictions contour defining the edge-tzu to heat flow;
- Step3. Checking matrix "code solution" to the existence of adequate solutions;
- Step4. If a solution is found, then the operation code decides on visualization heat flow in a certain way;
- Step5.If solution is not found or there are several solutions (add situation), then using a probability matrix is a solution with maximum probability;
- Step6. If the poll matrix "code solution" unique situation, absent from, in binary code relationships memory values selected the most suitable frames sector, where it is then the criterion of confidence Eden ratifies the most suitable situation;

Thus, the selection function is implemented by the new situation of choice (code binary operations) the most appropriate sector of frames in the knowledge base. Examples of rules in the Knowledge Base:

- Rule1. IF the coordinates of the distribution of the heat flow heater and the coor-dinates of the heat flow path of engineering networks are THEN calculate the re-sulting heat flow;
- Rule2. IF the resulting heat flow at a temperature above the optimum THEN find the area of the problem area;
- Rule3. IF I find a problem area zone THEN build a minimal vector to the contour of utilities to find on field problem;
- Rule4. IF I find a problem area or problem area THEN you give a certificate of non-optimal arrangement and recompose again. Example visualization component layout is shown in Figure 6;

Layout algorithm based on intelligent components, help to avoid some of the problems related to the visualization of the data in the calculation of the CAD module to reduce the error in the calculations, and to increase the visibility of the results, as well as to provide support for decision-making in the field of building automation systems. Efficiency calculations utilities can reduce the time for calculation of parameters walls and improve their accuracy, which is an important requirement in the design of buildings and structures. The need to use these components for the CAD due to the requirement to solve the problems of distribution of thermal heating elements, as well as the need for detection of problem areas. These tasks are currently among the most intractable in the environment of poorly formalized and demanding automation applications. The complex offers intelligent components when building CAD integration will allow more accurate visualization of the heat flows . This will increase the accuracy of calculations and impact in the future on the quality of the layout of the heating elements in the circuit utilities. At the initial stage of the algorithm takes the form analysis of changes in the

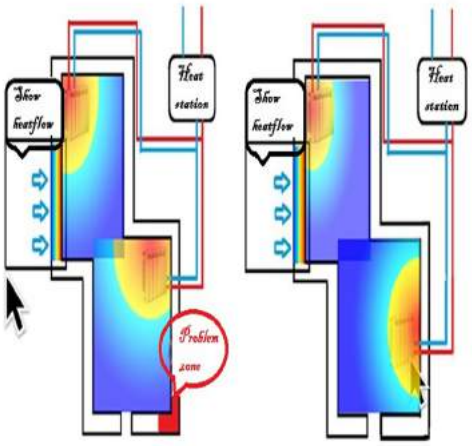

Figure 6. Example visualization component layout based on intelligent prediction

thermal circuit, which is initialized in the team to change the settings. When initializing is performed to detect the temperature sensors and the formation of the data samples. Based on the temperature data samples occurs recognition situation: the presence or absence of problem zones. The method of recognition of the situation lies in the ability to set ambient temperature conditions outside the contour, as well as granting councils in the case where the heat flux from the heater can heat the entire path. Problematic areas (PA) in this case will be considered the region in which the effect is minimal and insufficient heaters for heating engineering network or part of the air flow in the room.

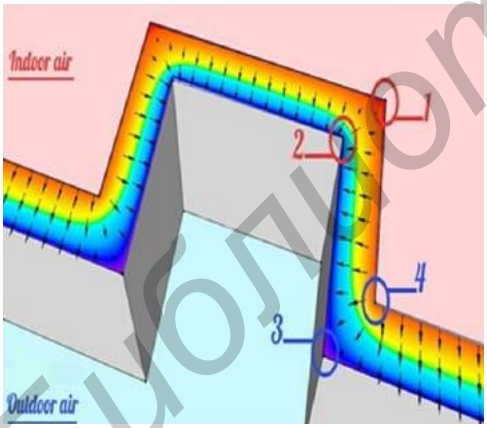

Figure 7. Visualization of detected PA with component layout based on intelligent prediction

Layout algorithm based on intelligent prediction, to avoid some of the problems related to the visualization of the data in the calculation of the CAD PD to reduce the error in the calculations, and to increase the visibility of the results, as well as to provide support for decision-making in the field of building automation systems. Efficiency calculations utilities can reduce the time for calculation of parameters walls and improve their accuracy, which is an important requirement in the design of buildings and structures. The need to use these intelligent components for the CAD PD due to the requirement to solve the problems of distribution of thermal heating elements in the construction, as well as the need for detection of problem areas. These tasks are currently among the most intractable in the environment of poorly formalized and demanding automation applications. The complex offers intelligent components when building CAD PD integration will allow more accurate visualization of the heat flows. This will increase the accuracy of calculations and impact in the future on the quality of the layout of the heating elements.

V. Conclusion

Thus, in the course of clarifying the nature of the distribution of heat flows in CAD PD to determine the magnitude of error of actual temperature values.Walling, that would solve a number of issues related to ensuring the required level of thermal protection of buildings, and to avoid violations of sanitary norms, ensuring a longer life of the structure and preserving its thermal properties. The effectiveness of the implementation of this intelligent technology forecasting at different stages of the design of buildings and structures, as well as an add-on CAD PD due to the reduction of time for calculations, higher precision, automation of related parameters associated with insulated construction, as well as the ability to take into account the relationship of the past influence on the final correction factor. Predictive forecasting component allow for visualization of the heat flows Walling insufficient even if the statistical information that can be used in engineering networks to reduce the total time for the design.

References

[1] Sorokin O.L., Sidorkina I.G. Analysis of representation of user information in the unit "Terem-4" for the temperature gauge walling // Cybernetics and programming. - 2015. - N 5. - p.193-198.

[2] Building codes and regulations of the Russian Federation. Rulebook: "Design Thermal protection of buildings": SP 23-101-2004. - Moscow: Tehnormativ 2013.

[3] Sorokin O.L., Sidorkina I.G. The module definition of a stationary regime in CAD external engineering networks // "IS & IT-Intelligent CAD 2015" Labour Congress on Intelligent Systems and Information Technology - Taganrog: SFU, 2015. Vol.1. - p. 70 - 75

[4] Sorokin O.L., Sidorkina I.G. The algorithms of information processing in the adaptive reconfigurable module CAD OK to render the heat flows circuits// «OSTIS-2016" Open semantic technologies of intelligent systems - Minsk BSUIR, 2016- p. 431 - 435.

ВНЕДРЕНИЕ ИНТЕЛЛЕКТУАЛЬНОГО ПРОГНОЗИРОВАНИЯ КАК КОМПОНЕНТА ТЕХНОЛОГИИ ВИЗУАЛИЗАЦИИ ТЕПЛОВЫХ ПОТОКОВ

Сорокин О.Л., Сидоркина И.Г.

Внедрение элементов прогнозирования, в составе средств систем автоматизированного проектирования ограждающих конструкций (САПР ОК), позволит избежать проблемы некорректного определения температуры в конструкции. На стадии проектирования здания прогнозирование позволит наиболее точно подобрать тепловые узлы и нагреватели для поддержания оптимальных климатических условий в помещении, а также повысить энергоэффективность работы тепловых пунктов.