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Experimental research and methods development of an efficiency estimation of intelligent power management state of the building systems of the real object

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ABSTRACT
The first step is collection of available climate data, information on the design of the buildings and structures and other factors that affect energy consumption. These data are entered into a software module that calculates and outputs data on loads on engineering systems of buildings and structures.
On the basis of climatic data is the annual dynamics of the loads on the energy. Then software package provides full simulation of buildings and engineering systems and issues indicators on energy consumption.
The obtained simulated data is compared with the actual energy costs to verify the accuracy of the model.
The second stage is the analysis of the impact of measures to improve energy efficiency on energy consumption. For this purpose, similar to the first stage, the software modules are inserted data (energy-efficient solutions) building physics and engineering systems with the proposed measures for energy saving. As a result, using the software module could be obtained new data on energy consumption and forecast energy costs.

Keywords: engineering systems, energy-ecological modeling, heating system, air conditioning system

INTRODUCTION
Developed under the lifecycle methods justification of evaluating the low-rise buildings system of smart power management effectiveness in the real object considers the consumption of buildings electric and thermal energy engineering systems to maintain the set parameters of microclimate in different types of premises [1]. The following engineering systems are:
• radiator heating;
• the system of natural ventilation;
• ventilation system;
• the supply and exhaust ventilation system;
• air heating system;
• steam air;
• moisture supply air in irrigation chamber;
• air conditioning system (cooling in a warm period).

As a real object was two floors Educational-laboratory buildings "MGSU". Fig. 1.1.1 shows the general view of the Educational-laboratory building..

Fig.1.1.1. General view of MSUCE Educational-laboratory building "

The building contains the following engineering systems:
• radiator heating;
• the supply and exhaust ventilation system;
• air conditioning system;
• lighting system;
• automated building management system:
– the heating control;
– the lighting control;
– the parameters of microclimate control;
– the power supply parameters control;
– the water supply parameters control;
– the heat supply parameters control.

Automated control building system contains:
• 100 power supply control points;
• 80 points heat supply control;
• 30 points water consumption control;
• 24 points movement control;
• 240 points light control;
• 240 points noise control;
• 240 points air temperature control.

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The system gives the opportunity to archive the engineering systems resources' consumption information for any period of time [2-3].

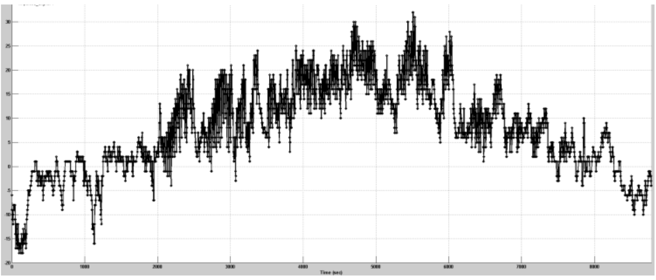

Fig. 1.1.2. The external temperature graph (2015year)

The following is the comparative analysis made by the authors' methodology of promising energy-ecological modeling in real object. As engineering systems was considered the heating system (HS) and the air conditioning system (ACS) [4].
Systems are separate. The HS is intended to compensate for the heat loss through the enclosures. ACS is intended for heating or cooling the supply air.
Consider the work of computer information technologies for the period equal to one day (7 January 2015) on one of the 203 Laboratory class [5].

Create graphics for consequence work:
• number of people visiting the cafe;
• setpoints schedule for air temperature in the premises;
• schedule setting relative air humidity in the premises;
• the outdoor temperature changes schedule;
• relative humidity outside air changes schedule.

№	Time, hour: min		Number of people
	start	finish	
1	0:00	8:00	1
2	8:00	9:00	88
3	9:00	:2	2
4	9:20	9:40	31
5	9:40	13:10	20
6	3:10	13:50	88
7	13:50	4:00	0
8	14:00	1 :10	28
9	18:10	18 50	88
10	18:50	21:00	80
11	21:00	23:00	34
12	23:0	0:00	1

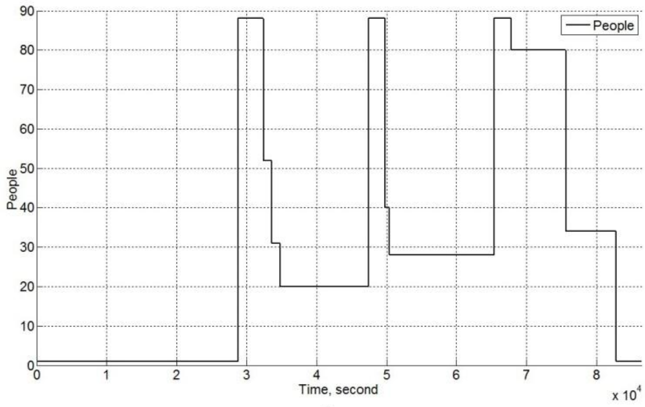

Fig. 1.1.3. Visitors' schedule

№	Time, hour: min		Temperature
	start	finish	
1	0:00	7:30	10
2	7:30	8:00	24
	8:00	22:30	24
4	22:3	2 :00	24
5	23:00	:00	10

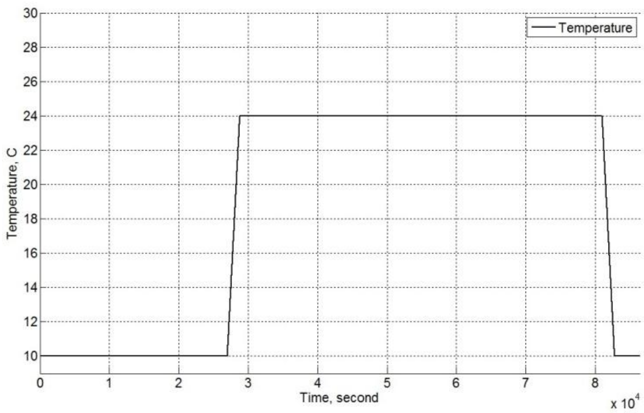

Fig. 1.1.4. Setting the room temperature schedule

№	Time, hour: min		Humidity
	start	finish	
1	0:00	7:30	40
2	7:30	8:00	45
3	8: 0	2:30	45
4	22:30	23:00	45
5	23:00	0:0	40

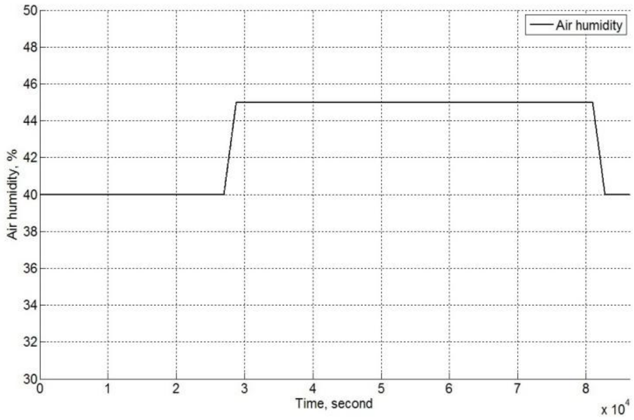

Fig. 1.1.5. Changing in the room relative air humidity schedule

№	Time, hour: min		Temperature
	start	finish	
1	0:00	3:00	-18
2	3:00	6:00	-18
3	6:00	9:00	-18
4	9:00	12:00	-15
5	12:00	5 0	-13
6	15:00	18:00	-14
7	18:00	21: 0	-15
8	21:00	0:00	-1

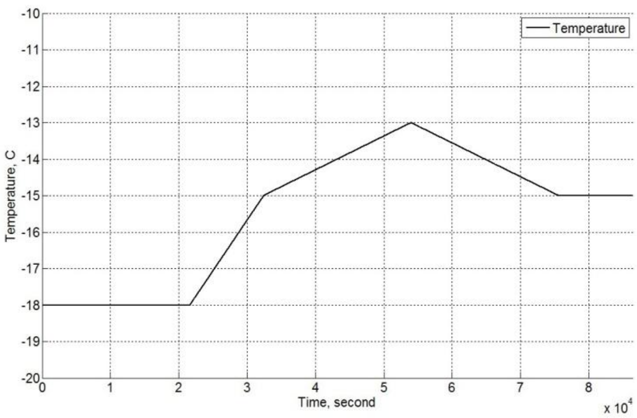

Fig. 1.1.6. The outdoor temperature changing schedule

№	Time, hour: min		Humidity
	start	start	
1	0:00	3:00	100
2	3:00	6:00	100
3	6:00	9:00	92
4	9:00	12:00	85
5	12:00	15:0	8
6	15:00	18:00	92
7	18:00	21:00	92
8	21:00	0:00	85

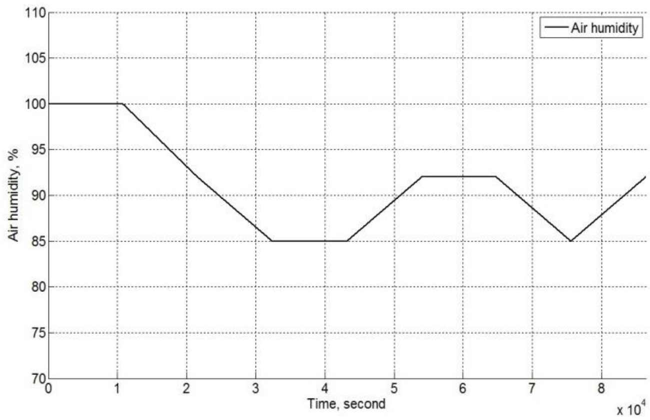

Fig. 1.1.7. Changing in the room relative air humidity schedule

The above given data in a computer environment, based on an established methodology it was obtained the following data (fig. 1.1.8-11):

- room air temperature change schedule;
- graph of relative humidity of air in a premise during the day;
- schedule of consumption of heat carrier in the heating system;
- schedule of flow through the heat exchanger supply air.

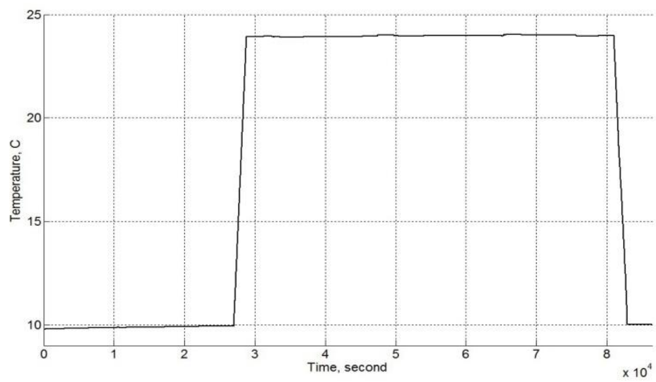

Fig. 1.1.8. Schedule of changes in air temperature in the room during the night

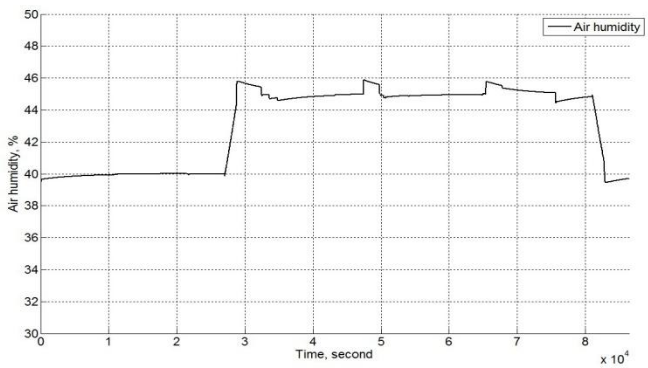

Fig. 1.1.9. Schedule air in a premise relative humidity during the day

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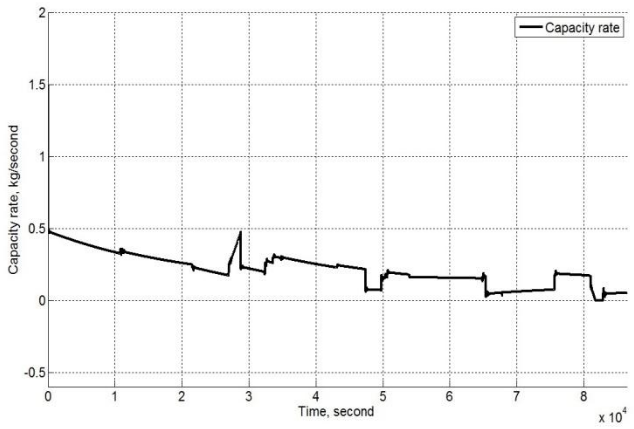

Fig. 1.1.11. Schedule of air flow through the heat exchanger supply

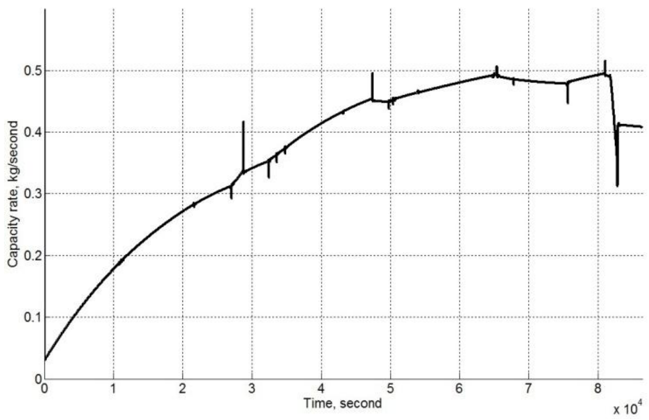

Fig. 1.1.10. Schedule of heat carrier in the heating system consumption

Fig. 1.1.12. shows General scheme of verification results of perspective energy-ecological modeling objects techniques (conditionally abstract low-rise buildings) and real intelligent control systems installed in the Laboratory complex (fig. 1.1.1)

It is easy to see that the difference between the data obtained using the perspective energy-ecological modeling methods and real values obtained from measurements, amounted less to 1.7%, this fact proves the model reliability and the possibility to implement the model in the energy-efficient technologies of creation and intelligent life-cycles' control framework to any type of low-rise construction and complex territories' development projects [6-7].

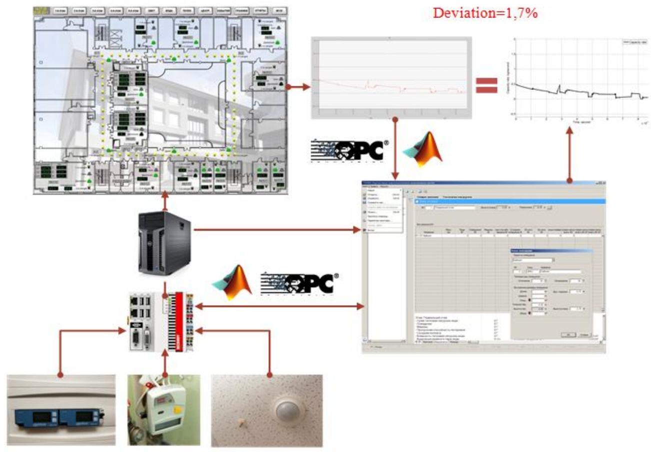

Fig.1.1.12. The general scheme of verification results

Conclusion

Positive results have allowed to use tools and mathematical model for the Technological Platform. According to the concept of long-term socio-economic development of the Kazakhstan Republic for the period until 2020 in the framework of national competitiveness, Science development, the national innovation system and technology assumes the tools development for promoting the interaction between scientific, educational organizations and business in the innovation sphere, including establishing technology platforms. In accordance with the definition given in the "Procedure of formation of the list of technological platforms", approved by decision of the Government Commission on high technologies and innovations, technological platform is a communication tool intended to reinforce efforts on promising commercial technologies creation and new products, attract additional resources for research and development through the participation of all stakeholders (science, business, non-profit organizations and the state). Against the innovation center, technology parks, clusters, technology platforms have no territorial restrictions. The analysis of the experience of the technological platforms in the European Union in relation to this work allows to identify technological platform as a self-regulating network Association of advanced scientific organization (MSUCE), industry-leading development companies (Ecodolie, GILSOCTROY and TITAN) and reputable non-profit organization (NAMIKS).

Scientific substantiation of energy saving technologies introduction and low-rise of energy efficient homes' construction materials in the villages "Ekodolie" was conducted using energy-efficient technologies of creation and intelligent life-cycles' control on the basis of a multi-functional research low-rise buildings resource efficiency engineering systems of complex intellectual monitoring and management.

Comparing the obtained values of power consumption with the base case, the system determines the percentage of energy savings and, consequently, economic action benefits from the implementation of activities. Comparing the cost of implementing measures with economic benefit is possible to determine the payback period measures and the feasibility of their implementation. Thus, this system of mathematical modeling allows to interactively monitoring the effect of the introduction of an intervention, to determine its feasibility and payback period.

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