DEVELOPMENT OF TECHNOLOGICAL COMPLEXES IN VARIOUS INDUSTRIES

РОЗВИТОК ТЕХНОЛОГІЧНИХ КОМПЛЕКСІВ У РІЗНИХ ГАЛУЗЯХ ВИРОБНИЦТВА

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ENERGY SAVING OPERATION STRUCTURES IN TERMS OF VARIABLE TEMPERATURE ATMOSPHERIC

Abstract: *The article contains an analysis of the impact of fluctuating temperatures of atmospheric temperature inside a thermal technical spaces, depending on the thermal inertia of the building. Properly used the influence of sinusoidal changes in external temperature on the internal temperature of a building will achieve the reduction of energy costs to maintain specified thermal conditions in the room. The actual harmonics waveforms atmospheric temperature is presented in the article based on selected measurements carried out in the vicinity of Lublin in the period of one year.*

Keywords: *heat transfer, energy, energy saving in thermal technical spaces*

INTRODUCTION

Heat changes processes occurring in various fields of technology and technology is a usually phenomenon because it takes place everywhere where there are temperature differences. This type of issue heat is closely associated with the amount of energy and thus its rational use and most of all her savings. The problems of saving energy on the threshold of the twenty-first century becomes even mostly important than in the seventies years of the last century, when it first appeared the energy crisis associated with the armed conflict in the Middle East. This conflict continues to this day varying degrees swollen and concerns control over energy sources too.

As we know, heat exchange is carried out in three different ways in terms of physical, ie. by heat conduction, lifting the heat - or convection and by the thermal radiation. Conduction is most important form of the heat exchange process, involving the exchange of heat between the directly touching parts of the same body or different bodies in the form of a transfer of kinetic energy of microscopic motion of molecules. Conduction of heat in solids is impermeable for thermal radiation and in liquids, where there are moving relative to each other is kroskopowych-part of the liquid. Besides the three mentioned types of heat transfer, we also have to deal with their combination in the form of heat transfer (penetration) and heat transfer. Heat transfer involves the exchange between a solid and a fluid, i.e.. The liquid or gas, and the heat transfer is the heat transfer between two exchanging factors divided by the wall - between the medium (liquid) at higher temperatures and the medium of lower temperature.

The applied methods of design partitions of buildings take into account the climatic conditions, unfortunately, only in a static way - the average air temperature in the region. However, as is well known, changes in ambient air temperature are inherently dynamic, which component is present in a variable dose, variable component decade, monthly or even annual etc.

1. SAVING ENERGY IN ROOMS IN THE ASPECT OF INERTIA HEAT

Despite the great interest in the dynamics of re-flow of heat through the partition, experimental studies of this kind of process is not progressed significantly forward because of the difficult process of measuring and individual nature of heat transfer dependent variable and unique climatic conditions.

Therefore, designing an external multi-layer baffle chamber should be the reality the dynamics of atmospheric temperature changes into account, because it has a significant impact on energy saving chillers or heating a room of a building. The positive impact of external temperature przejawiałby in the form of amplitude attenuation changes in the internal temperature (e.g., daily cycles). Attenuation it will be done by moving - most preferably about half of the period - the impact of sinusoidal temperature changes on atmospheric climate of the interior space. This effect is to achieve owing to the thermal inertia of the building, which would also support more energy efficient equipment used in the air conditioning and heating. The time constant that reflects the inertia of the barrier will be obtained through the choice of construction materials due to their physical properties, thickness and number of layers of the wall. At this point, mention should be made so. thermostability structure, which is closely related to the shape of the temperature change sinusoidalnym atmosferycznej and adequate thermal inertia property and, in particular, the outer baffle. The easiest way to explain this phenomenon - it is about the amplitude attenuation of the emerging changes in temperature inside the chamber by harmonic changes in the outside temperature. Thus, this attenuation is the result of the phase flux vector of heat transmitted into the room.

To take advantage of the so-called property. thermo-stability of the structure, create the appropriate model of mathematics and physics of the building and its external compartments. In the case of treating the partition as part

of linear lumped, the possibility of simple modeling of thermal processes using electric analogy. This method uses the Ohm's law and using the so-called. RC terminal network is as thermal processes. An example of transfer function G (s), the inert object of the first order has the form

$$G(s)=\frac{Y(s)}{X(s)}=\frac{k}{T\cdot s+1}$$

where: X (s) Y (s) - the transform size, respectively the entry and exit
k - gain
T - time constant.

The value of the time constant T expressed eg. in hours, obtain the product of the thermal resistance $R=\frac{\delta}{\lambda}\left[W^{-1}m^2K\right]$ and the capacity of the partition, $C=\rho c_w\delta\left[J\cdot m^{-2}K^{-1}\right]$ ie. (T = RC).

These volumes contain specific physical values of building materials specified by the standards.

To solve the problem of transfer of heat through the wall can also be used the Fourier equation. This type of modeling requires knowledge of calculus and computer programming to determine a solution with appropriate boundary conditions.

In order to attain the assumed waveform changes in temperature inside the chamber depending on the temperature changes of atmospheric temperature measurements made with the simultaneous recording of the emerging heat fluxes for the test on a laboratory walls of a polystyrene and brick red. A series of measurements for brick adequately prepared for dry and wet. The external surfaces of the tested samples have been subjected to different temperatures close to the actual values used in many refrigeration.

2. DYNAMICS OF ATMOSPHERIC TEMPERATURE CHANGES AND ITS IMPACT ON BUILDING MICROCLIMATE

Until recently, the problems concerning the thermal spaces construction statically resolved, it means, that the buildings and especially their outer peripheral wall were tested due to the thermal resistance at a set passage of heat through the barrier. Temperatures studied manifested on the inner and outer layers possibly on the walls granicach individual layers.

The results obtained enable control of these temperature from different technical points of view, such as, for example, due to the demand that temperature partition the internal thermal insulation has never fallen below the dew point and thus, that there is no moisture concentrates the wall structure. It is known that the emergence of moisture in the material of the septum causes a significant drop in the value of insulating walls and increase accelerates its destruction [1].

It is true that in this stage of the study the transition of heat could specify specific requests due to the optimization of energy consumption, since the systematic study allowed not only to design a suitable insulating layer in the outer partition, but allowed to get a real view on the penetration of moisture through the thermal insulation to the wall and thus shape each idea on the impact moisture the value of the heat flux.

With this kind of studies, we found that the previously used method of measuring the internal temperature of the heat chamber are technical mostly cases inadequate because only the temperature of the convection of the thermal technical spaces, which in turn does not give any image on the impact of radiation on the temperature the chamber and stored in the product (especially regard to refrigerators or storage of food products). It follows that requires accurate analysis of the temperature of both the air inside the chamber and the surface temperature of the wall and therefore the analysis of the transmission system property of atmospheric temperature – outsite wall and atmospheric temperature - internal room temperature and which is the inertia or thermal inertia, the study of dynamic properties should be particularly taken into account.

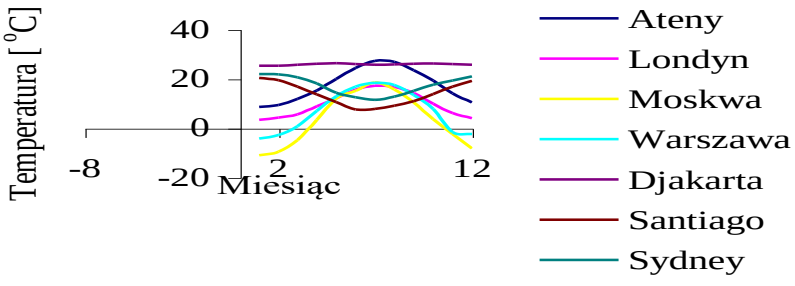

Fig. 1. The average temperature air for selected cities in the Word In one year

It is obvious that every object in our geographical location, ie. In the central - eastern and northern parts of Europe, is subject to the influence of periodically changing the atmospheric temperature - Figure 1. Fluctuations temperature that are short-term, expressed period daily changes in temperature during the day and night and the long-term, expressed period annual temperature changes in the form of slow growth temperature from winter to summer and a similar drop in temperature from summer to winter. It is not just about the atmospheric temperature but with a resultant temperature ensuing the components of convection, radiation and temperature derived from the radiation area adjacent to the relevant object, or from secondary radiation.

Through the appropriate use of the thermal inertia of the chamber can be achieved very favorable damping effect of these periodic changes tempera¬tury external temperature in the room. Conversely, poorly chosen design of the building can these temperature fluctuations, as long as the thermal inertia is in phase with the periodically changing temperature, atmospheric strengthen on an unimaginably wy¬soką value. For example, the daily changes in atmospheric temperature detrimental to the indoor climate is the effect of heat flow from the interior of wnątrz- occurring after the 24 - hour phase shift. In contrast, most preferred is a case in which the housing is po¬siadało outer baffle capable of producing 12 - hour phase shift vector flow of heat and result in suppression of the temperature change in the building.

So in order to achieve measurable economic effects in the process of maintaining the desired temperature in the facility must be in the design of the exterior wall into account not only thermal resistance but also heat capacity of the partition. The product resistance and heat capacity of the septum, which has the dimension of time units is characterized by inertia time constant of the object taken into consideration by the applied control systems.

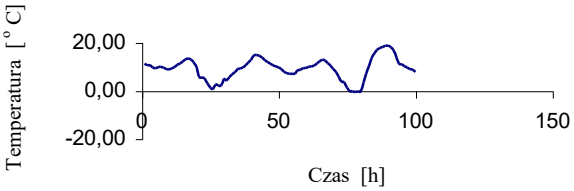

Fig. 2. Runs daily atmospheric temperature recorded in and around the city of Lublin in the first three days of the month of April

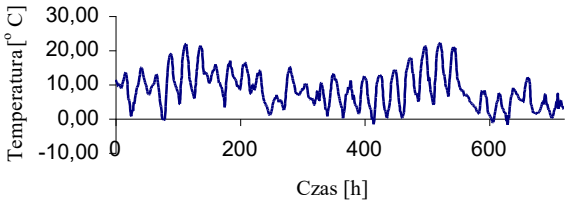

Fig. 3. Runs atmospheric temperature recorded in and around the city of Lublin in April

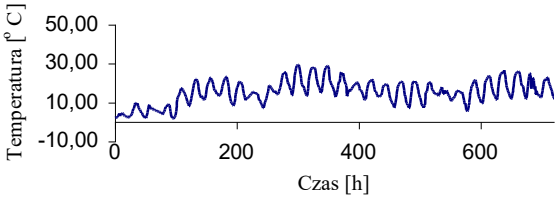

Fig. 4. Runs atmospheric temperature recorded in and around the city of Lublin in the month of May

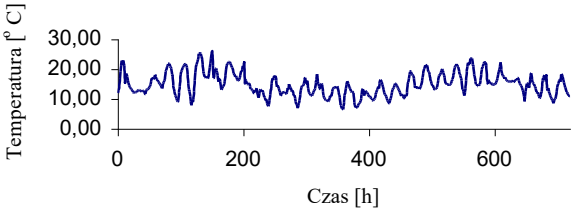

Fig. 5. Waveforms atmospheric temperature recorded in and around the city of Lublin in the month of June.

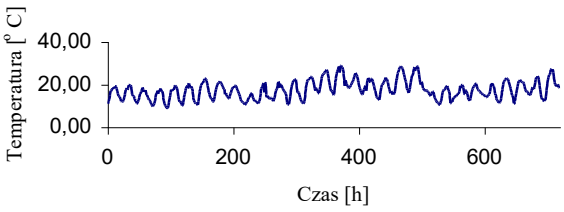

Fig. 6. Waveforms atmospheric temperature recorded in and around the city of Lublin in July

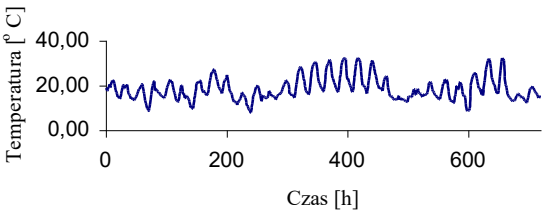

Fig. 7. Runs atmospheric temperature recorded in and around the city of Lublin in the month of August

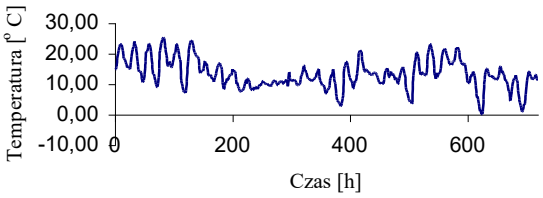

Fig. 8. Waveforms atmospheric temperature recorded in and around the city of Lublin in September

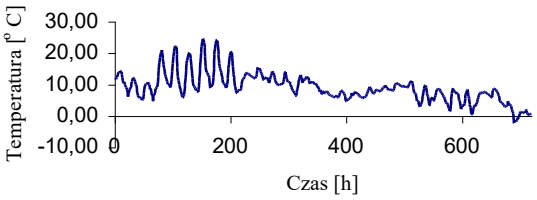

Fig. 9. The course of the atmospheric temperature recorded in and around the city of Lublin in the month of October

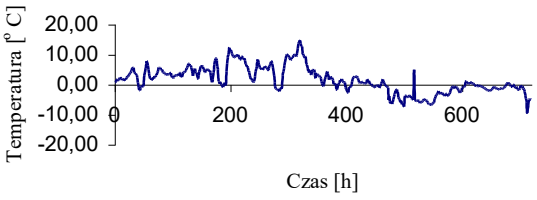

Fig. 10. Waveforms atmospheric temperature recorded in and around the city of Lublin in the month of November

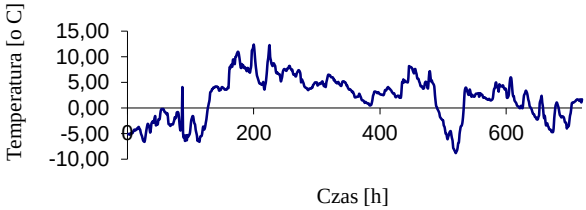

Fig. 11. The course of the atmospheric temperature recorded in and around the city of Lublin in December

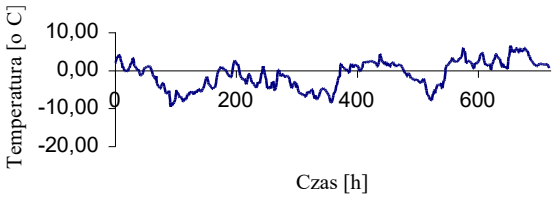

Fig. 12. Waveforms atmospheric temperature recorded in and around the city of Lublin in January

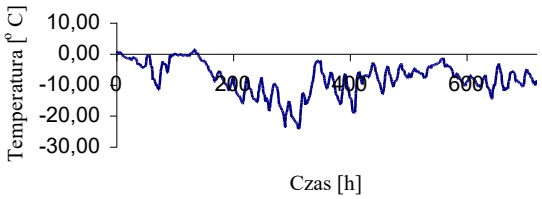

Fig. 13. Waveforms atmospheric temperature recorded in and around the city of Lublin in the month of February

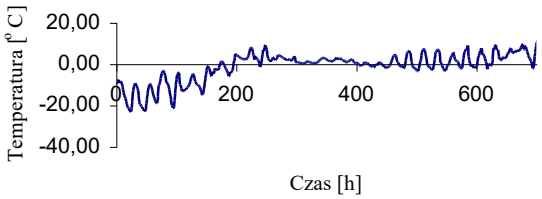

Fig. 14. The course of the atmospheric temperature recorded in and around the city of Lublin in March

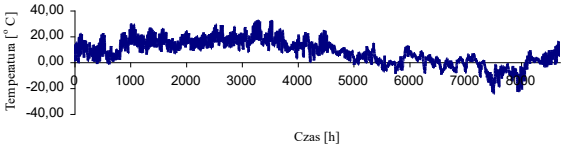

Fig. 15. Waveforms atmospheric temperature recorded in and around the city of Lublin in the period of one year (from April to March)

Both the daily (Figure 2), monthly (Figures from No. 3 to No. 14) and annual (Figure 15) real courses of changes air temperature registered during one year in the region of Lublin show the harmonic nature of the changes of atmospheric temperature. The above presented characteristics are appointed by one hour step measuring is noticeable the presence of the minimum and the maximum of these changing in the period of daily, monthly or yearly atmospheric temperature. Moreover, based on the graph shown in Figure 15, we can see the difference between the course of the curve for the maximum and the course of the curve for the minimum daily temperature.

In practice, we can get confirmation the above presented considerations regarding the thermal stability objects even on the example of existing to this day medieval buildings, eg. churches, libraries and castles in which there is no need to use air conditioning during the hot days of summer and In the period of winter special heating. So today appropriately constructed wall - bulkhead will obtain significant savings of energy required to maintain a certain temperature inside the buildings.

CONCLUSION

Analysis of thermal processes addressing the problems of building physics are necessary with the problems of the saving energy which is consumed for the operation of buildings. In particular energical effects are noticeable of savings for the case of the storage room having the maximum ownership of thermo-stable in the sense of periodic changes in day and night, as evident from the harmonic nature of the changes of temperature. Then the energy consumption for cooling or heating facility in this type of construction is much lower than in a similar property poorly constructed designed stability due to the heat, ie. Does not exhibit a phase shift of 12 - houres heat flux, although an automated system adjust the equipment cooling or heating equipments there were set to optimal adjustment.

REFERENCES

[1]. Carlslaw H., Jaeger J.: ”Conduction of heat in solids”. Oxford University. 1959.
[2]. Janczarek M., Skalski P., Suchorab Z.: „Przewodzenie ciepła przez przegrodę w stanach ustalonych i nieustalonych” – INFORMATYKA W TECHNICE Tom I., Lubelskie Towarzystwo Naukowe Lublin 2006/2007
[3]. Janczarek M., Skalski P., Bulyandra A., Sobczuk H.: „Przewodność cieplna zewnętrznych ścian budynków w aspekcie wilgotności i oszczędności energii” – Rynek Energii nr 4 (65) sierpień 2006. Kaprint – Lublin 2006.
[4]. Janczarek M.: „Wyznaczanie bilansu cieplnego komór chłodniczych” – XII. Konf. Nauk. – Techn. Rynek Ciepła 2006 – Materiały i Studia. Kaprint – Lublin 2006.
[5]. Janczarek M., Bulyandra O.F.: „Zbierigannia fruktiw u gazowich serediwiszczach” HARCHOWA PROMISLOWIST NR 5 UDK 664(04)(082) – KYIV, UKRAINE 2007.
[6]. Janczarek M.M., Bulyandra O.F., Szapowalenko O. I., Winogradov-Saltykov W.A.: „Osobiennosti rasczieta tiepłowowo balansa tiepłowych kamer chranienia fruktow” – Naukowi Praci, wipusk 31, tom 2 – Odesska nacionalna akademia charczowych technologii – Odessa - Ukraina – 2007.
[7]. Janczarek M.M.: „Determining of coefficient of heat transfer in bricks depended from degree of their moisture” – CEEPUS WEB Summer School 2007 ”Informatics Systems in Automation”, University of Maribor – Maribor, Slovenia – 14 th - 28 th September, 2007.
[8]. Janczarek M.M.: „The analysis of wall temperatures in a fruit storage in the aspect of transient heat flow” – Engineering Mechanics 2009. Svratka, Czech Republic 11 – 14 th May 2009.
[9]. Janczarek M.M.: „Technological describtion of heat and mass transfer processes in thermal treatment of fruit storage chambers” – Engineering Mechanics 2009. Svratka, Czech Republic 11 – 14 th May 2009.
[10]. Winogradov-Saltykov W.A., Janczarek M.M., Fiedorow W.G., Kiepko O.I.: „Tiepłometriczeskije issliedowanie tiepłozaszczitnych swoistw ograżdienij” – pages 116 – 123. Industrial Heat Engineering – International Scientific and Applied Journal – Vol. 31., Number 4/2009 – Kyiv, Ukraine.
[11]. Janczarek M. M.: "Heat and mass transfer processes in thermal treatment chambers for fruit" - Monografia Robotics and manufacturing systems. Wyd. Politechniki Lubelskiej, s. 192 - 202, 2014.
[12]. Janczarek M. M.: "Analyses of heat transfer through walls of thermal technical spaces with computer helping" - Applied computer science - nr 4, vol.10 s. 756 -83. 2014.