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Comfort problems at intermittently heated spaces?

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***Abstract* – The thermal comfort in ours buildings today became a huge challenge. To get for occupants good conditions for life we must design the building elements and the heating systems such that internal temperature remains constant even during the interruption of the operation of the heating systems and with a good thermal protection we get the same thermal comfort for all rooms - basement current floor or last floor.**

***Keywords* – buildings elements, energy, thermal comfort, heating systems.**

1. INTRODUCTION

The building sector continues to be the largest energy consumer and is the second largest CO_2 emitter after the industry sector [1].The number of buildings that exist today far exceeds the number of new buildings constructed in the next decades, energy renovation of buildings plays a key role in efforts to reduce energy consumption and environmental loads [2], [3], [4].

Buildings are responsible for 40% of the Union's final energy consumption and 36 % of its energy related greenhouse gas emissions, while 75 % of the Union's buildings are still energy inefficient [5].

Improving the energy efficiency and energy performance of buildings through renovation is a major aspiration Energy efficiency is the safest and most cost effective way to reduce energy expenditure in buildings[5], [6].

Considering the reduction of dependence on natural gas, the European Commission proposed to ask the members states to limit to 19℃ the temperature provided by the heating systems in public buildings and to 25˚C for the conditioning systems [5].

The intermittent operation of the heating system in a building has a consequence the variation of the internal air temperature and the temperature on the inner surface of the walls. As the air cools, at the same internal humidity content, the relative humidity increases, so the dew point temperature also increases. The temperature drop on the inner surface of the walls causes the appearance of condensation, the especially in the hours when the heating systems not working.

It is known that in the case of buildings in which the operating time of the heating system is less than 15 housper day, the heat requirement will by increased by 50 % for 10 hours per day, 35 % for 11 hours per day, 25 % for 12 hours per day, 15% for 13 hour per day, 7% for 14 hour per day.

Checking the risk of condensation on the inner surface of construction elements is done by determining the superficial temperature factor (according SR EN ISO 13788).

The criterion for evaluating the risk of superficial condensation and mold on the inner surface of buildings elements is the superficial temperature factor and reflects the level of insulation in different points of the buildings elements:

-to ovoid mold;

$$fRsi > 0{,}77\ (0{,}80)$$

- to avoid the risk of condensation;

$$fRsi > 0{,}70$$

For a correct design of new buildings and energy rehabilitation solution for existing buildings is necessary that the value of superficial temperature factor to be higher then 0.80 [7].

In this paper we propose to analyze the occurrence phenomenon of condensation on buildings elements under the conditions of intermittent operation of heating systems.

2. EXPERIMENT DESCRIPTION

The superficial temperature factor is calculated with relation:

$$f\_Rsi = (\theta si-\theta e)/(\theta i-\theta e)=(R-Rsi)/R \quad (1)$$

So, if the value of this factor is higher then critical value:

$$fRsi > fRsi,\ critic \quad (2)$$

The phenomenon of condensation on buildings elements will not appear.

In our analysis we will consider a building with a internal temperature set at 19℃ (UE recommended) with a heating system that work for 10 hour/day, 12 hours/day and 15 hours/day. The heating system use hot water at nominal parameters 90/70℃. The building does not benefit from thermal protection of the walls and ceilings.

To evaluate the influence of working time of heating system against internal air temperature in the building, we assumed that heating system will not assure the heat of the air with now other source and during the working time the final temperature will not be 19℃.

In present the standard SR EN 12831, [8], take in consideration an additional thermal load to design the heating system in a building using a heating factor, applying this factor to the thermal load the internal temperature come back to the set value of calculate. When the heating system operates with intermittence even when the temperature of thermal agent is higher the internal temperature in building can’t come back to the normal value according with the value of external tenperature.

If we analyze the heat lost in a building, the number of floors influence de hygrothermal regime of rooms: the connection with basement, the variation of surface soil temperature, the humidity from rains will lead to high surfaces of condensation on the buildings elements.

The rooms placed at last floor the condensation will appear in the place of thermal bridges (attics, the connection between walls and roof, walls and reinforced concrete elements etc).

The rooms located on the corner of building, the condensation surfaces will lead to high heat lost. In these conditions we propose to high the thermal resistance for buildings elements from basement and for buildings elements from last floor. In this way in all the rooms from a building the thermal comfort will be assure.

3. RESULTS AND SIGNIFICANCES

In conditions presented above we evaluate the variation of internal temperature when the heating system operate 8h and we obtain a value by 11.59℃, for 12 hours working 15℃ and for 15 hours working 19℃.

If we would take in consideration the presence of people in the building the results would be different. People transfer to the environment water vapor. In room with no ventilation system because of moisture release, 31 gramme/hour and person, the humidity grows to 1.29 gramme/kg air. The consequence of this humidity grow is grow of relative humidity to 100% when the initial relative humidity was 50% in 4 hour approximate and the condensation could be avoid.

4. CONCLUSIONS

We can observe from our analysis that the functioning heating systems influence the appearance of condensation on the surface of buildings elements. When the heating system work continuous the temperature on surface of buildings elements is higher than the dew point temperature and the superficial temperature factor is higher than 0.8.

Ensuring an additional thermal protection for the external buildings elements along with the continuous operation of the heating system and the increased the massiveness of buildings elements will lead to accumulation of heat in the walls and ceilings.

5. REFERENCES

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