Thermographic inspection for building diagnosis

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Abstract. Thermography (infrared thermal imaging) is one of the non-destructive methods by which surface temperature variations can be determined on the surface of a building. By this method one can exemplify, at one time, the heat loss through the surface of the building. Thermovision consists of scanning the building with infrared, using a special camera. This allows us to identify the hottest areas where the greatest heat loss occurs. On the basis of the information obtained, the optimal solutions for reducing energy losses can be established, resulting in a better environment for buildings and lower costs in terms of thermal energy, and not only. Thermal camera recordings are converted into color images. The range of colors and color intensity give us insights into temperature differences from the surface of the building under test. All of this creates an overview of the entire building, so construction specialists can make a fair interpretation and offer the most appropriate solution for the issue.

Keywords: thermography, thermovision

Case study

This work is the result of a thermography study of a residential building located on 119 Ferdinand Boulevard in Bucharest. This study was carried out at the request of the beneficiary because there were high energy consumption to achieve thermal comfort in the apartments.

In this study we used a Testo 885-2 thermal imaging camera. With its help, professional thermography works can be carried out covering the whole range of industrial and civil constructions and their related facilities.

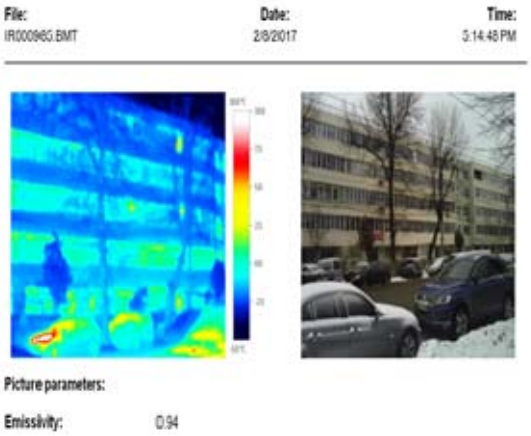

Fig. 1. South- east façade of the building

The date of the thermographic inspection is February 7, 2017. The outside temperature was -3 degrees Celsius and the outside humidity 92% rH.

As we can clearly see in the both figures no. 1 and no. 2 there are some areas where the heat loss signature is increased due to some collateral facts that do not have anything in common with building insulation.

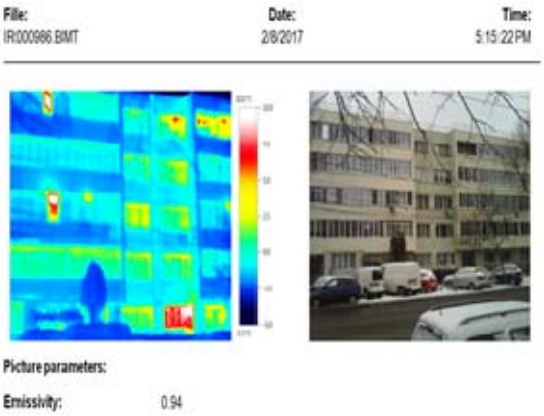

Fig.2. South- east façade – continuation

The red and yellow areas are due not to poor isolation, but rather to open windows to the kitchens, through which hot air is evacuated; as well as the use of a lower quality bottle when closing the balconies.

As time goes on, the constructions as a whole, but also the materials they are made of, undergo certain changes due to use, degradation, but especially due to exposure to environmental factors. What undergoes changes are the thermotechnical parameters of the building as a whole and of the building materials from which the installations are made. In the following two figures, 3 and 4, the last two entrances of the block are shown, where some areas where there is a worse insulation or where the joints have not been covered properly can be seen, even with the naked eye.

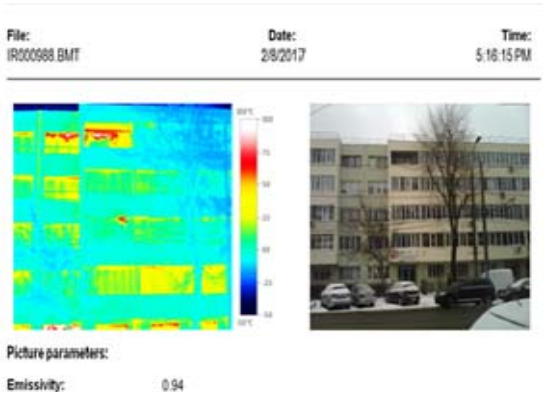

Fig. 3. South -east façade – last entrance

This method also helps in discovering hidden flaws that create an increased discomfort within the premises. Here, reference is made to non-insulated thermal bridges that can also generate dampness and insulation cracks that can cause a continuous cold feeling.

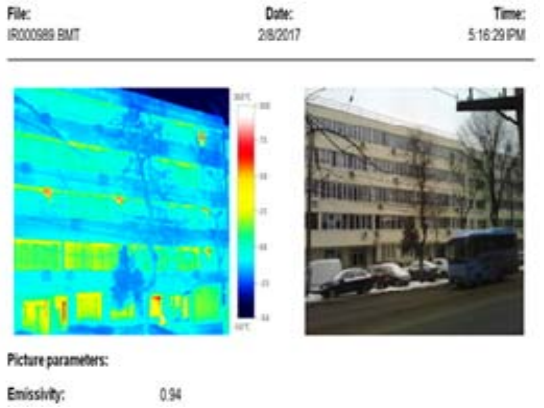

Fig. 4. South -east façade – last apartments.

This thermography is done only externally to determine the potential loss through the building envelope. Figure no. 5 is one of the most expressive, within it being noticed, how much the thickness of insulation, its quality and the quality of glass matters.

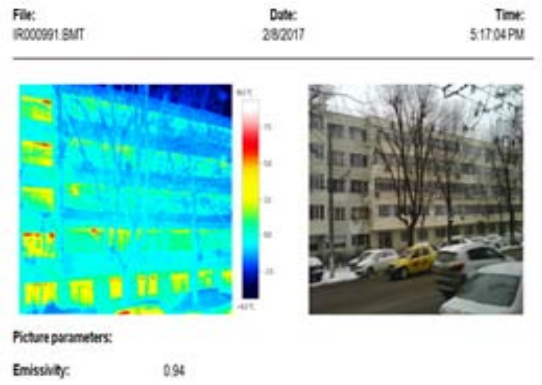

Fig. 5. East corner view

In order to have an overview, the thermo-thermography is done on the entire building so that the maximum risk areas can be observed.

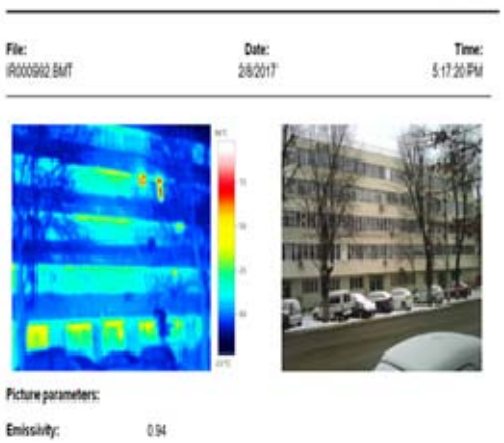

Fig. 6. Caption of the Figure 1. Below the figure

In figure no. 6 there is a large loss of heat through the windows on the ground floor. It is clear that the balcony is not warmed up properly and there is a risk that the mold will appear at the top.

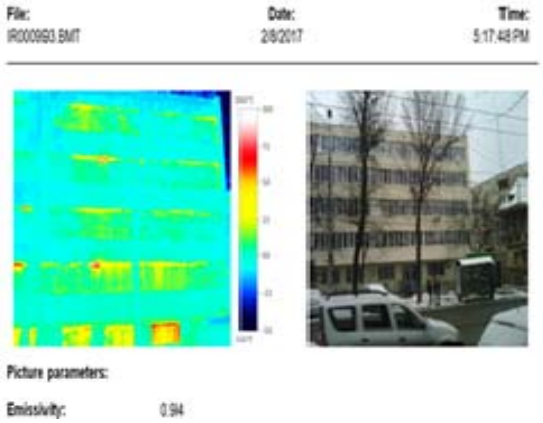

Fig. 7. View of the west end.

The next step in determining heat loss is the actual calculation. A check can be made if the insulation is the right one or should be thicker. The following figures show how to isolate the corner of a building. There is a more pronounced yellow to red color area, an area that is an open window. There is a pronounced blue area. This is the air temperature in the area.

Given the obstacles ahead of the building, the observations made are conclusive. The apparent temperature on the building is consistent with the outdoor air temperature. Thermal points specific to a poor isolation are no longer visible, which indicates that the thermal insulation applied has the expected effectiveness.The thermal field is distorted by some open windows and the air conditioners that are mounted on the façade.

Depending on the angle of view, the windows at the upper levels reflect the image of the sky. The thermal image of the balconies is influenced by the relationship with the room or the heated space. Windows can be fitted with curtains or blinds, can also be opened or closed. All these factors influence the thermal image. Depending on the angle at which the thermography (angle of view) is made, the image of the sky is reflected in the top windows. The image of the balconies is directly influenced by the heated space and the relationship with the thermal imaging camera.

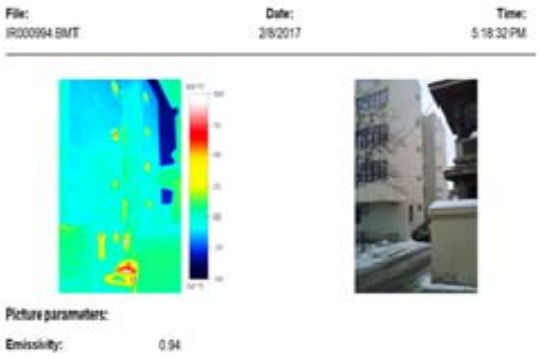

Fig. 8. West corner view of the building

The windows have some general features present in most of the records. Frames and window frames represent a thermal bridge with a difference of about 2-3 degrees Celsius. This is why in the upper part there is a slightly higher temperature than the rest, which should not be interpreted as a thermal bridge.

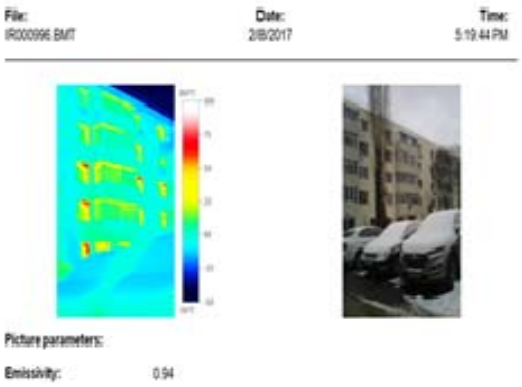

Fig. 9. View along east side of the building

As it is known, thermal imaging is a key element alongside the energy audit and energy performance certificate. All of this in one place competes in providing a detailed picture of the energy status of that space.

Results

In this situation, the use of thermal imaging applied to this building has led to the observation of the key elements related to heat loss and heat transfer. We must not neglect that this method is much used only during the cold period of the year. It can be

done during the summer only if a cold air source, whether it is air-conditioning or just conditioning, starts in the room.

This method, corroborated with the calculation of the energy certificate, could provide a technical and economical solution, obviously in close collaboration with the designated architect, for the problem of thermal discomfort in the building. Considering that the building is an average age for the city of Bucharest, which was built in 1985, from concrete slabs with quite large joints between them, and the quality of the primary insulation was of a poor bill, the following solution was offered for the reduction thermal discomfort: replacing glasses where appropriate with some of the highest quality or installing protective films to reflect ultraviolet rays.In order to preserve the architectural structure of the facade, it was used to insulate on the inside with extruded polystyrene where appropriate. Where there is an open balcony - installing solar protectors to reduce heat inputs from the outside.

Applying all of these methods resulted in a quick, cheap and lasting result.

Conclusions

These temperature measurements give us a qualitative picture of the degree of thermal protection of various areas of the building that is subject to the process, highlighting mainly thermal bridges and other weaker areas, as well as any possible defects (whether they are visible or hidden).

This method, thermovision, is one of the best non-destructive and non-invasive methods, making it useful in the following situations:

- determining areas with heat loss of buildings, identifying deficiencies of thermal insulation;
- identification of excessive air infiltration;
- determining the areas where condensation and mold are likely to occur;
- identifying clogged pipes;
- determining constructive issues, and so on.

At the same time, elements of poor quality from the thermal point of view can be determined: the exterior of the doors / windows. It is possible to detect sanitary or heating installations hidden in walls / floors (when they are in operation). The radiated heat of the installation leads to a temperature variation on the surface of the building element in which they are embedded. Water infiltrations in façades / pedestals / terraces can also be detected if these infiltrates affect the outer layers, visible through the process of building thermography (building thermography), because wetlands have different temperatures than dry areas.

The entire thermovision procedure in construction offers optimum results when the temperature difference between the outside and the inner environment is approx. 20 ° C.

Following the thermography inspection, a specialist engineer measures the surface temperatures of the inspected item by means of a thermographic camera. The thermography chamber measures and interprets the wavelength of the infrared ray radiation emitted by the measured body. This gives you some point maps that are then

converted by the device into a color image. The color intensity and palette is consistent with temperature differences from the surface of the measured body.

Other thermal applications are in the industrial field. It can detect operating faults and operating parameters to determine if the machine is prone to a fault. It is used for corrective maintenance but most importantly for preventive maintenance, the role played by it being defining.

Of the areas of interest in which this method is used, we mention:

- Detection of imperfect, corroded electrical contacts
- Thermovision of furnaces
- High voltage installations, voltage poles, transformers, transformer stations
- Determination of thermal parameters for transmission boxes, motors, bearings, bearings, pumps, other machine parts.
- Determination of thermal parameters for air conditioning systems, evaporators, radiators, compressors, cold / heating installation routes.
- Determination of thermal parameters for air intake systems, braking systems, complex systems.

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