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INFRARED THERMOGRAPHY FOR BUILDING INSPECTION

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Abstract: *Modern thermography is based on the ability of an infrared camera to register the heat emitted by the surface of the body, detect any irregularities surface radiation temperature, and it turns into a picture, so called thermogram. IR thermography is now displayed as an extremely useful tool in the study and advancing energy efficiency in buildings. Thermal imaging systems are used by the military to detect, recognize and identify enemy personnel, equipment and buildings. Simply put, they can be used to evaluate the „health“of any electrical or mechanical component. This paper presents infrared inspection surface of insulation (TIM) and the temperature on the outside wall. (Skylight in this paper) calculated values in the software package MatLab 7.12.0.635 (R2011a), taking into account the counting errors, were compared the measured data with thermal cameras Wöhler IC 21 and shown on the IR thermogram. The results of this calculation method of energy at the surface are compared with the values obtained by IR measuring.*

Keywords*: Thermography, energetic efficiency, energetic loss.*

1. INTRODUCTION

Thermographic images using parts of the structure can be quickly identified disadvantages associated with thermal characteristics, to discover the causes and recommend remediation. The possibility of contactless and remote recording of the total observed surface temperature field facility offers great advantages compared to conventional analysis of the structure. The application is just as useful on existing facilities, facilities under the protection and new facilities.

2. TESTING METHODOLOGY

2.1. Thermal imaging system

The thermal imaging system (Figure 1) creates an electronic picture of the scene. The picture may be converted to color (pseudo color or false color) where reds indicate hot areas and blues represent cool objects. When presented in black-and-white, the brightness (more white) indicates hotter objects. When the electronic picture is printed, it becomes a thermogram. A thermogram is simply a map of thermal energy where shades of gray or colors represent different levels of radiant energy.
The conversion back to black-and-white does not provide the original gray scale.

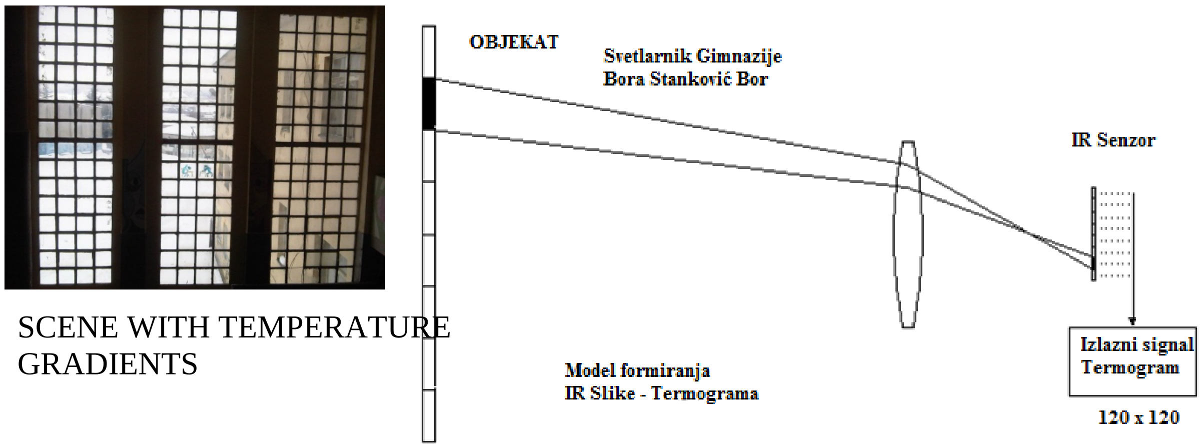
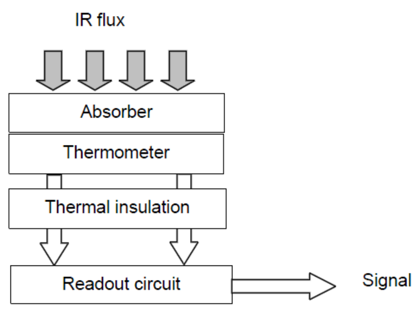


Figure 1. The process of making thermograms –
Thermogram and visible image of the window Bora Stankovic in Bor

2.2. Thermal detectore structure

The schematic structure of an uncooled thermal detector is shown in figure 1. As a general rule, these detectors measure the temperature rise due to IR radiation absorption by a thermally insulated element. For this purpose, thermal detectors are mainly composed of an infrared absorber embedded in closed contact with a thermometer element. The thermometer element senses incoming IR induced temperature rise and converts it into an electric signal. The most common detection mechanism is the resistive bolometer whose resistance changes with temperature, but various other mechanisms can be used, such as pyroelectric effect, thermoelectric junction, P-N junction conductivity or thermal stress induced mechanical deflection. Considering a two dimensional array of detectors, a readout integrated circuit (ROIC) is generally designed to measure the resistance of each bolometer and to format the results into a single data stream for video imaging purpose. Finally, due to the strong correlation between thermal insulation and sensitivity, the high performance uncooled IR detector must be operated under vacuum – typically 10-2 Torr – in a specific package supplied with an infrared window [5].



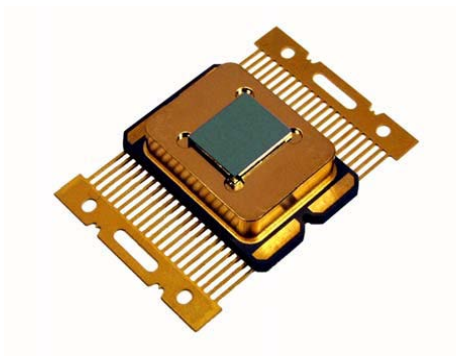


Figure 2. Schematic structure of thermal detector   Figure 3. ULIS ceramic package developed for 160 x 120 microbolometer IRFPA

3. RESULTS AND DISCUSSION

In the experiment, we thermovision recording facilities of public importance, IR images of windows, provided by Bora Stankovic high school in Bor. The original image is 120x120.

Equipment and software for thermal imaging

In the experimental part of this paper used a digital thermal imager Wöhler IC 21, whose operation is based on uncooled germanium thermo-electric line detector. It formed the thermal image by measuring infrared radiation of the entire body or a particular scene. The software, which contains a camera, makes the necessary corrections when converting the thermal image in the corresponding thermogram, which is the accurate approximation of the temperature recording facility, or the temperature distribution in the scene. One advantage of the camera IC 21 is a wide temperature range, or it can in a single picture to show large differences in temperature. Running on standard batteries for video cameras. The images are displayed on a color LCD screen diagonal 10.2 cm.

Digital thermal imaging camera, by American standards, represents high technology. In this case the used thermal imager IC 21 producers Woehler Woehler GmbH. This camera belongs to a class of digital infrared thermal imagers. With these cameras one can measure temperature without touching the object whose temperature we want to measure. Thermal Imager is a very effective tool for measuring the temperature and is easy to use. [1]

Digital Infrared Thermal Imager is based on patents electronic thermal and covers the range of effects from -20° C to 3500° C, where the thermal sensitivity < 0.1 °C. Measurement accuracy

Range of measured temperatures :	- 20 °C do 1200 °C
Measurement accuracy:	± 2 °C
Thermal sensitivity:	< 0.1 °C
Detector type:	FPA, 320 x 240
Spectrum:	3.6 □-5m □m
Set of batteries :	4 metal hydride batteries
Operating temperature:	- 15 °C do 50 °C
Weight :	2 kg
Dimensions :	220 x 132 x 140 mm

thermogram is shown as a matrix of 120 x 120

1 120

10,86	10,92	10,79	10,66	10,46	10,2	10,14
11,7	11,25	10,99	10,86	11,05	10,66	10,53
11,83	11,83	11,31	10,79	11,05	10,79	10,79
12,09	11,96	11,7	11,64	11,7	11,05	10,59
11,83	12,09	11,51	11,57	11,18	11,05	10,99
12,35	12,03	11,64	11,64	11,57	10,99	10,53
12,03	11,96	11,96	11,7	11,25	11,05	10,92
11,9	11,77	11,38	11,31	11,25	11,05	10,46
11,38	11,38	10,73	10,59	10,92	10,53	10,46
11,31	11,25	10,92	10,86	10,73	10,33	10,33

120

I Histogram

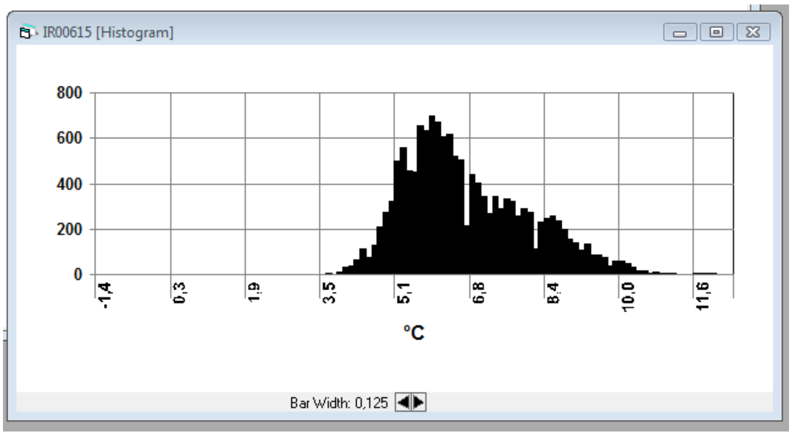


Figure 3. Histogram IR 615

Software package was used SnapViewPro Version 2.1. to generate thermograms:

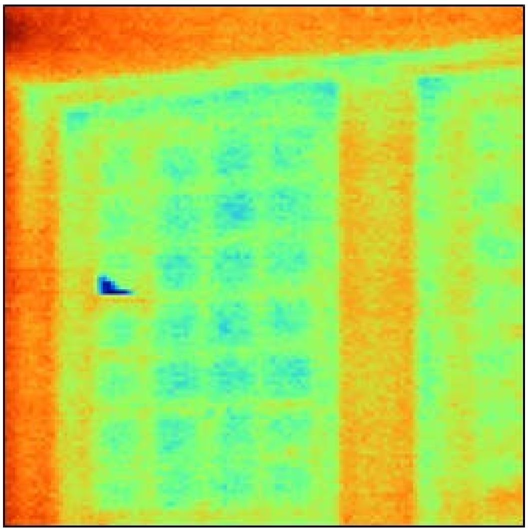


Image Path	D:\ZVONKO\TERMOVIZIJA \TERMOVIZIJA GRADJEVINA\GIMNAZIJA BOR\IR00615.ISI
Image Date/Time	11/02/2010 17:49:29
Report Date/Time	23/05/2011 17:37:23
Temp Unit	Celsius
User	Bora Stankovic high school in Bor
Location	SRB-19210 BOR
Target	

Figure 4. Report prepared in IR 615 SnapViewPro software package Version 2.1

Data processing in the software package Matlab results are obtained as in Figure 5.

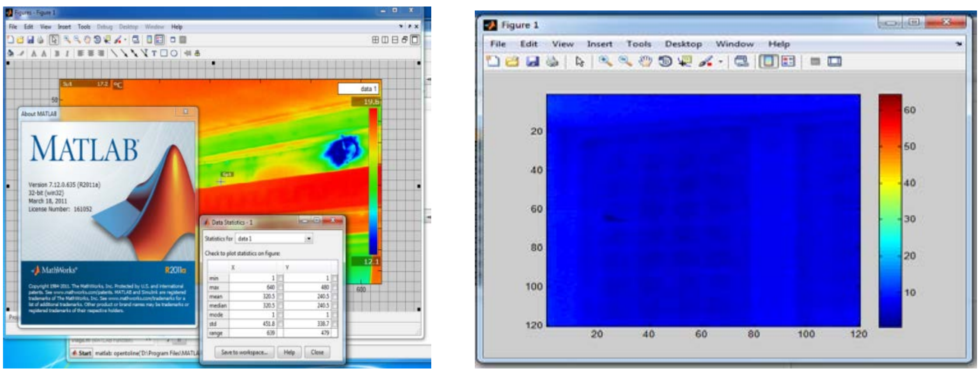


Figure 5. Report IR 615 was prepared in the software package MatLab ver. R2011a.

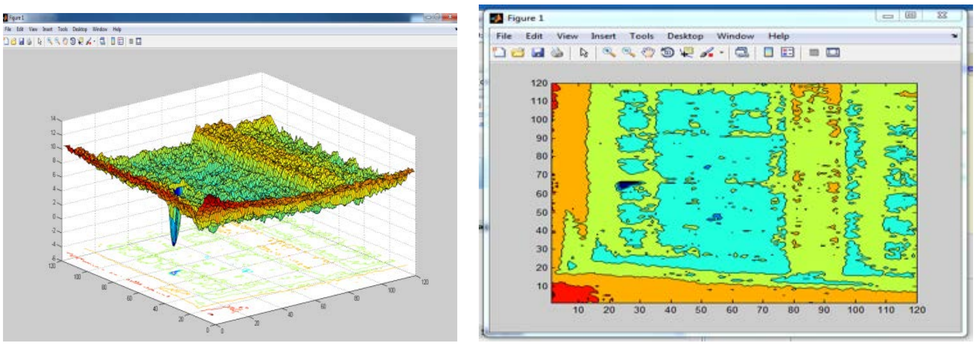


Figure 5 . Report IR 615 was prepared in the software package MatLab ver. R2011a.

4. CONCLUSION

A large part of total energy consumption in the exercise of thermal comfort in buildings. Infrared thermograph I proved to be an extremely useful method for visualization of heat loss through the construction elements of the research potential of increasing energy efficiency in buildings. Thermal imaging of buildings and subsequent expert interpretation can locate design flaws and focus interventions on the rehabilitation of the optimal improvement of energy efficiency building systems.

Shortcomings in the structure that can determine the thermographic recording are: inhomogeneity of the material of the wall, irregularity or lack of thermal insulation, moisture in construction, problems of flat roofs, thermal bridges, culverts open-air ventilation system, joints and the like, as the concentration in the wall installation. In addition, infrared thermograph can detect small leaks or damage the system in terms of leaking installations built into the walls and / or energy channels, but also the possible defects and damage to the built-in installation of insulation that can not be established ordinary visual inspection system.

In developed countries Thermography is increasingly common method of controlling the required transfer facility, followed by regular monitoring and maintenance of facilities, especially facilities for public use. Analysis shows that the introduction of modern principles of energy efficiency in construction provides energy savings 50-80%. In the long term, with expected increased prices of energy and raising the awareness of energy saving and environmental protection, infrared thermal imaging method will certainly find a large application in the construction industry in the preparation of the building energy passport.

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