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# THERMAL-BRIDGE ASSESSMENT IN GLAZING AND ALUMINIUM FRAMES BY THERMO-IMAGES: A CASE STUDY

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## ABSTRACT

This paper presents the experimental analysis and results of a thermographic inspection performed on aluminum window frames of an instructional facility. The investigation was carried out using thermal images to map the energy loss and gains through aluminum window and door frames on several rooms of the building that houses the School of Technology of the Polytechnic Institute of Bragança in Portugal. The results obtained are discussed in detail and a retrofit strategy is proposed based on the thermal analysis.

***Keywords:*** thermal bridges, thermography, thermal insulation.

## INTRODUCTION

Construction of modern buildings presents a great challenge towards the improvement in building energy efficiency and the implementation sustainable building policies and legislation to achieve the so-called near zero-energy buildings (NZEB). Although near zero-energy design of new buildings is a positive step, the main problem is related with energy demand reduction in a high number of energy-inefficient existing buildings making more critical to incentive the refurbishment of existing buildings rather than to demolish and replace them with new constructions.

It is well-known that thermal heat losses and gains through the building envelope are mainly due to energy transfer through the glazing and window frames. Energy can also be lost by infiltration around the window frame, conduction through a frame as well as by radiation through the glazing surface (also a small amount of energy is also lost through convection within the glazing cavity). Although metal frame design have been enhanced considerably over the last decades, early metal frames with simple sections and without thermal breaks are present in most existing buildings becoming the main weak spot in improving the energy performance of such buildings. Evaluating thermal heat losses and gains in these construction components can be helpful to determine the best retrofit strategy to increase energy efficiency while ensure optimal thermal comfort based on cost-benefit analysis.

Non-destructive testing methods and non-contact measurement devices such as infrared thermography (IRT) cameras provide powerful tools for quickly and accurate data visualization and analysis of temperature distribution of entire surfaces. Thermal imaging have evolved significantly to the point that affordable and compact medium resolution thermal imaging cameras are now available for building applications. Usually, energy auditors and maintenance technicians use thermography to locate overheating points to identify faulty devices, machinery components or electrical equipment damage, but also to locate leakages, moisture detection and to inspect buildings.

In this regard, the aim of this study is to identify thermal losses and how they are distributed in glazing and aluminum frames of an existing building using an infrared scanning inspection. An affordable FLIR camera is used to record daily temperature distribution measurements of glazing and frames over a period of several months in selected rooms of the building that houses the School of Technology of the Polytechnic Institute of Bragança in Portugal. In this case, original windows/doors feature single-glazed units with simple aluminum frame.

## RESULTS AND CONCLUSIONS

The thermal information is used to evaluate the heat losses and gains through window and door glazing and frames. Climatic data from a local weather station is used to validate the outdoor temperature and the thermal measurements. The results based on the analysis of the thermal images captured on the surface of the window/door are used to characterize the performance of the glazing and surrounding frame. Temperature variation throughout the day was recorded and analyzed (Figure 1).

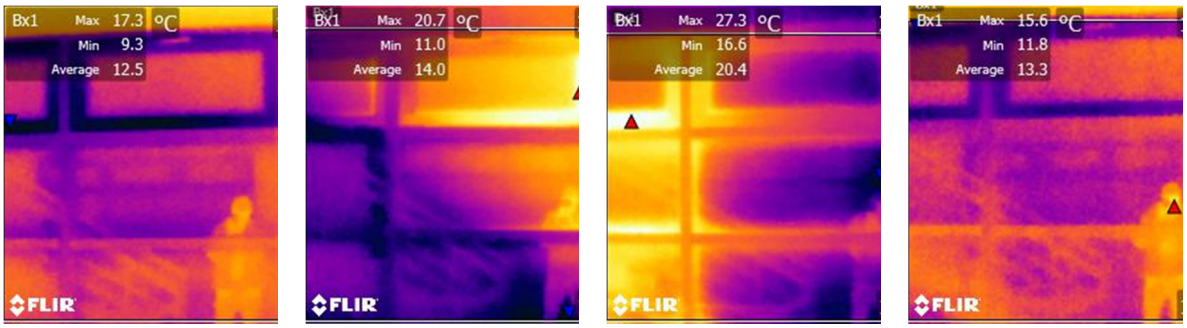


Fig. 1 - Thermal images for heat losses and gains glazing analysis.

A thermal bridge analysis was carried out to identify critical heat loss points allowing cost-effective retrofit measures to be defined in order to improve the performance of the glazing and window frames and increment the energy efficiency of the building envelope.

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