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Thermography methodologies for detecting energy related building defects

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ABSTRACT

Thermography is becoming more widely used amongst construction professionals for energy related defect detection in buildings. Until quite recently, most of the research and practical use of building thermography has centred on employing a building walk-around or walk-through methodology to detect sources of unacceptable energy use. However, thermographers are now creating new building thermography methodologies that seek to address some of the known limitations, such as camera spatial resolution, transient climatic conditions and differences in material properties. Often such limitations are misunderstood and sometimes ignored.

This study presents a review of the existing literature, covering both well-established and emerging building thermography methodologies. By critically appraising techniques and observing methodology applications for specific energy related defects, a much clearer picture has been formed that will help thermographic researchers and thermographers to decide upon the best methodology for performing building thermography investigations and for the invention of new approaches.

Whilst this paper shows that many of the different passive building thermography methodologies seek to address particular building issues such as defects and energy use, it has also demonstrated a lack of correlation between the different methodology types, where one methodology is often chosen over another for a particular reason, rather than making use of several methodologies to better understand building performance.

Therefore this paper has identified the potential for using several passive building thermography methodologies together in a phased approach to building surveying using thermography. For example, a less costly and faster survey could be conducted to quickly identify certain defects before enabling more time consuming and expensive surveys to hone in on these with greater detail and spatial resolution if deemed necessary.

Contents

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1. Introduction

Buildings are estimated to be responsible for 40% of the EU's total energy consumption [1]. Legislation has given greater impetus for improvements in construction and material standards, as new and existing buildings endeavour to become more energy efficient. This is further strengthened through the UK government's carbon reduction targets of 80% on 1990 levels by 2050 [2]. Although this target aligns more with energy performance than building defects, it can be argued that heat loss from defective building components such as thermal bridging and draughts directly relate to a building's overall energy performance [3,4]. Space heating accounts for over 60% of domestic energy use in Britain [5] and with energy prices rising [6], conserving heat can contribute to improved comfort levels, lower energy bills and fewer households experiencing fuel poverty.

Many non-destructive methods and tools are currently available for building energy use investigations [7], including heat flux measurement, co-heating tests, automated metre reading, air-tightness testing and computational simulation, each one addressing a particular aspect of building performance. As an emerging technology within the construction industry, thermography is another tool which can be used to help identify common sources of heat losses in existing and new buildings, such as those from ventilation and conduction [8]. Fig. 1 shows an example thermal image of the Plymouth University campus. Unfortunately, thermal images are often misinterpreted, especially where thermal mass, reflections and moisture might have an impact on readings and thermal performance.

Currently, thermography professionals and academics are undertaking work which seeks to develop new methodologies for detecting defects and to measure the thermal performance of existing buildings using building thermography. This paper seeks to review and compare the differences between current passive methodologies.

2. Thermography for building analysis

In 1800, astronomer Sir William Herschel discovered the infrared portion of the electromagnetic spectrum [9]. This was utilised in 1840 by Herschel's son, Sir John Herschel who utilized

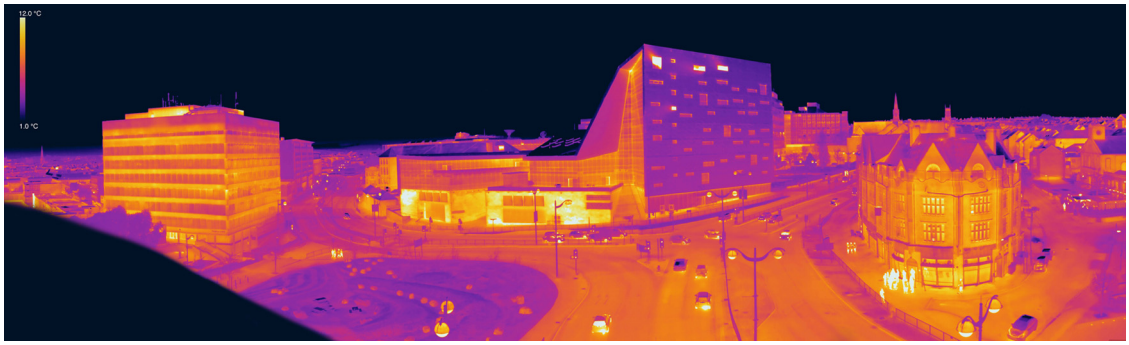

Fig. 1. Thermal image of Plymouth University campus.