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Drying evaluation using infrared thermography

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Abstract

The effect of moisture in buildings is normally related with damage, which may occur due to the presence of moisture itself or due to its evaporation. The drying process plays an important role in the available moisture, both inside the material or at its surface, so its evaluation is of great importance. Infrared thermography (IRT) is a non-contact and non-destructive testing technology that can be applied to determine the surface temperature of an object. It is commonly used as a diagnostic tool, enabling studies related to the thermal behaviour of building elements as well as to identify anomalies and degraded areas. Although less common, IRT is also used to assess moisture in building components.

In this work it was analyzed the applicability of IRT to assess the drying process of exterior walls after a long-term rainy weather. The test campaign started when the rain period stopped and a period of sunny days began. To assess the drying process, besides infrared camera, it was also used a moisture detector to evaluate qualitatively the walls' moisture content. Measurements were carried out during six consecutive days without rain, at 10:00, 12:00, 14:00, 16:00 and 18:00. Two walls were assessed: one facing southeast, exposed to direct solar radiation, and one facing northeast, with no incident solar radiation.

Moisture detector results show that the walls dry out along the test campaign, being the drying process more intense in the wall facing southeast. That is mainly related to the fact that the wall was exposed to direct solar radiation during a longer period, which enabled the drying process to be fastened. The results obtained with both methods were combined and the opportunities and limitations of IRT to assess the drying process in outdoor conditions were discussed.

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Keywords: Infrared thermography; drying evaluation; surface temperature; dynamic measurement

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1. Introduction

The problem of moisture in buildings has always aroused great interest, since moisture is one of the main causes of buildings' pathology. Damage may occur due to the presence of moisture itself or due to its evaporation. Therefore, the drying process plays an important role in the available moisture and its evaluation is of great importance. Moisture and the drying process may cause degradation of building materials and components, compromising their performance concerning durability, mechanical resistance, waterproofness and appearance. It can also cause unhealthy conditions for users, resulting from biological growth and degradation of materials and building components.

Moisture content is traditionally assessed using destructive procedures, which require collecting a wall sample to be weighed in the laboratory. However, moisture content can also be assessed using non-destructive techniques using moisture detectors. These techniques may not be as accurate as the destructive procedures, however, they are very easy to use and they deliver results in real time.

Infrared thermography (IRT) is a non-contact and non-destructive testing technology that determines the surface temperature of an object expressed as a thermal image, where each color corresponds to a certain range of temperatures (Fig. 1). Two approaches can be used to obtain the surface temperature distributions using infrared cameras: the passive approach and the active approach. The thermal images can be analyzed qualitatively or quantitatively [1]. IRT enables to assess the thermal behaviour of building elements and allows identifying anomalies and degraded areas [2-8]. Although less common, IRT is also used to assess moisture in building components [9-11] as changes in moisture content can be related with changes in surface temperature due to: evaporative cooling at the moist area, reduced thermal resistance and increased heat storage capacity of the moist material. However, only indoor conditions were tested in these researches. When one intends to assess IRT potential in outdoor conditions, several additional constraints appear.

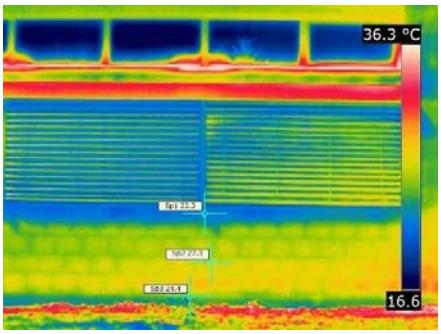

Fig. 1. Example of thermogram (building façade).

In this work, the passive approaches were used in the thermographic measurements to assess the walls drying process. The physical phenomenon underlying these measurements is the effect of evaporative cooling. Simultaneously, a moisture detector was also used to evaluate qualitatively the walls moisture content evolution. The results obtained with both methods were combined and the opportunities and limitations of IRT to assess the drying process in outdoor conditions were discussed.

2. Set up of the experimental campaign

To assess the applicability of IRT to evaluate the drying process of walls after a long-term rainy weather, a test campaign was carried out. It started when the rain period stopped and a period of sunny days began during March 2014. Two different devices were used: infrared camera (FLIR ThermaCAM E300 – Fig. 2a) and moisture detector (Tramex MRH III – Fig. 2b). Before the measurements were carried out, calibrations procedures were performed according to the operation manual of each device. Measurements were carried out during six consecutive days