

Characterization of Envelopes Thermal Transmittance based on a mixed approach

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Thesis Summary

Characterization of envelopes thermal transmittance based on a mixed approach

In the region of Wallonia, there are a large number of buildings constructed in the 1960s, after World War II. These buildings have significant heat losses in their envelopes and facades. This problem causes a significant increase in the energy consumption of these buildings, which is becoming an unsustainable situation for the environment.

This study proposes a method of identifying the thermal losses of building envelopes by focusing on the estimation or calculation of the thermal transmittance (U-value) of building facades. The three methods used are thermal image estimation with a hand-held camera, real-time monitoring using heat flux sensors and U-value calculations according to the ISO 9869 standard.

In addition, this work elaborates a methodology to estimate heat losses in a fast and efficient way employing aerial thermography using Unmanned Aerial Vehicles (UAV). As a UAV equipped with a thermal camera is not available, a methodology is developed using a drone with a normal camera that uses images of the building of the residence of the University of Liège to elaborate a 3D model in order to print it on a 3D printer and evaluate the accuracy of the method and to serve as a basis for future research into 3D thermal modelling of buildings.

In the methodology section, the three methods of calculation or estimation of the thermal transmittance of the building walls are described in detail. Also, a 19-step methodology is developed on how to obtain a 3D printing of the building from images captured with the drone.

The results obtained for thermal transmittance show that the most accurate method is real-time monitoring. A fairly good estimation is achieved by thermal imaging, which is close to the value of the monitoring estimation. As far as the calculations according to ISO 9869 standards are concerned, they are far from reality and confirm the degradation of the insulation of the building walls. With the results obtained, a comparison of the three methods is made in terms of accuracy, speed, cost and usability.

Following the elaborate methodology of 3D modelling from images of the Dorne, a 3D printing with good accuracy is achieved, which serves to validate the elaborate method.

Finally, the results obtained are discussed and the research questions raised are answered. The strengths and limitations of the work carried out are also presented, and finally, future research work is defined.