

## **Identifying the Possibility of Using Unmanned Aerial Vehicles in the Process of Construction Projects Implementation**

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### **1 Introduction**

Unmanned aerial vehicles have been used in recent years in the civil market in a variety of economic sectors. They usually support aerial photography or filming. The equipment is available for almost everyone. In most cases, it is necessary to have ground-based staff to install or operate the platform itself and its systems. It should be noted that unmanned aerial vehicles combined with appropriate detectors and sensors are an excellent method of diagnosing and controlling the technical condition of objects. The combination of a thermal imaging camera and an unmanned aerial vehicle provides a useful tool for thermal imaging tests that can detect areas such as heat escapes from a building, thus preventing heat loss and significantly reducing building operating costs.

### **2 Author's Own Research**

Testing with the use of thermal imaging in open field may be subject to errors resulting from the so-called environmental factors. Direct sunlight strongly affects the readouts from the thermal imaging camera. Both sunlight and shade can affect the distribution of surface temperatures of the building for hours after the sun has stopped shining. Therefore, differences in thermal conductivity can lead to major temperature differences. Rain, which lowers the surface temperature of the material, is an equally dangerous factor. The evaporation of rainwater cools the material, which leads to a disturbed temperature distribution (Cwojdzinski, 2014)

When using a thermal imaging camera to detect insulation gaps or energy losses, it is best if the temperature difference between the inside of the building and the outside is at least +10 °C. With a high-resolution camera of high temperature sensitivity, the temperature difference can be smaller. Therefore, building inspections are often carried out in winter.

Currently, the authors are also conducting research on the application of UAV in the following areas:

- drawing up three-dimensional, detailed maps of the buildable lands, containing relevant data and information that may be of particular importance for the study phase and during conceptual preparation;
- ongoing monitoring of the construction site and work in progress;
- controlling and supervising the works performed by the contractor, as well as supporting persons responsible for supervision;
- control over the supply of building materials and specialist equipment to the construction site;
- simulations that will provide the client with information on the topography and suggest what the best place for foundations excavation would be;
- monitoring the location of construction equipment that changes its position on the site, as well as supervising employees, properly performing their assigned duties and complying with occupational health and safety rules. The authors' preliminary research shows that the application of UAV in the above mentioned projects will improve the effectiveness of their implementation.

### 3 Conclusions

Decreasing prices and increasing availability result in growing popularity of UAV. Thanks to the autopilot function, the device is easy to operate for almost every user. Determining parameters such as flight speed and altitude, flight course, monitoring of objects or phenomena in hard to reach locations is not a major problem. The possibility of using UAV with thermal imaging or HD cameras makes unmanned aerial vehicles a useful tool for conducting various types of tests. The conducted tests indicate that it is possible to identify areas of heat loss in the building and assess the temperature distribution. Moreover, the result is fast, accurate and non-invasive thanks to the use of an unmanned aerial vehicle combined with a thermal imaging camera. It allows, among other things, to identify defects in buildings, such as missing insulation, mortar flaking, dampness problems, and to assess the condition of heating, ventilation and air-conditioning systems. Such measurements are not only accurate, but also very cost-effective. Regular autonomous UAV flights may provide in a short period of time current and detailed data concerning the implemented construction projects.

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