Thermography of the Extensive Green Roof of the Brno-Komín Kindergarten

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Abstract

The article deals with the behavior of an extensive green roof in winter. The behavior of the green roof of the Kindergarten Brno – Komín is described in the case study. The condition of the roof was determined using thermovisual technology. An extensive green roof shows significant temperature differences in winter compared to roofs without vegetation. The vegetation layer on roofs partially acts as an insulating layer. From this structure, the ventilation shafts and sanitary equipment emerge thermally. As part of thermography, the influence of the revision segment on heat conduction was determined. The overall thermal technical condition was evaluated using a thermal camera.

Keywords: thermography, temperatures, extensive green roof, vegetation layer, Brno-Komín

Introduction

The aim of the work was to analyze the behavior of an extensive green roof during the winter period, when the temperature drops well below the freezing point. The basis for ascertaining the state of the existing phenomena on the vegetation roof was the recording made with the help of a thermal camera, which was taken in the early hours of the morning.

The analysis of thermographic conditions on the green roof follows on from obtaining values of the remaining moisture in the substrate of the green roof. The humidity of the green roof also has an effect on the temperature values in the area, when with a large balance of humidity, the area of vegetation is colder than a roof with low humidity. A frozen substrate without a lot of moisture has a higher temperature as a result than a substrate with a lot of moisture.

Extensive green roof

Green roofs are a modern phenomenon, although their use has been documented since ancient times. It is a specially created garden located on the roof of a building that has exactly given layers and vegetation. However, the construction of the building must be adapted to build a green roof before construction. Roof gardens are most often divided into two types: intensive and extensive. For the intensive one, it is possible to use a wider assortment of greenery, which, however, requires higher cash inputs for maintenance and irrigation. Drought-resistant species that do not require such frequent maintenance are often used as extensive greenery. [1]

Green roofs are not only beautiful, but mainly functional and useful. "Green roofs act as natural ecological air conditioning. They oxygenate, cool and humidify the surrounding air and thereby disrupt the phenomenon of urban heat islands. This includes the thermal stability of the building, heat loss and protects the supporting structures and waterproofing against UV radiation," calculates Marcela Kubů, director of the Association of Mineral Manufacturers (AVMI). Thanks to the expanding trend of sustainability in construction, green roofs are seen as a normal and common feature of construction, not a luxury. [2]

The essence of an extensive green roof is vegetation with a maximum degree of self-regulation, able to maintain an adequate quality without regular watering and with only minimal human care (usually 1 to 2 times a year inspection, removal of unwanted vegetation, fertilization according to the type of substrate and development stage of the growth). The selection of plant species used must be adapted to the habitat conditions as much as possible. [3]

Pre-grown vegetation mat type S5

The pre-grown vegetation mat on a rotting coconut carrier interwoven with polypropylene (PP) mesh is intended primarily for flat vegetation roofs. The mats contain a layer of substrate and a mixture of several species of the Sedum genus rooted in it. They can also be used in tram tracks (it is necessary to prevent contact of plants with road salt and its leachates). The delivered length of the mat can be adjusted according to the request. [4]

Measurement details

Measurements with a thermal camera took place in the morning from 6:30 to 6:50. This time was chosen due to already partial visibility and minimal thermal noise from the surroundings. At this time, the heating system was already operating in the building at operating temperatures. The temperature values on the roof varied depending on the material of the structures and also on the places where the ducts of air conditioning and sanitary technology passed through the roof structure.

Measurement

Temperature analysis

A large difference between the temperature of the air handling unit body and the surrounding material was captured in dark vision images of shaft penetrations. [Figure 1] The lowest temperatures were shown by the construction of the attic sheeting and aluminum profiles around the perimeter of the roof, where the aggregate was poured. Likewise, very low temperatures were experienced by the lightning conductor, which is routed along the entire roof in the shape of a square net. The ventilation shaft was divided into two parts and according to the picture it was clear that only one part of the vent was in use, therefore the body shows a temperature difference on both sides.

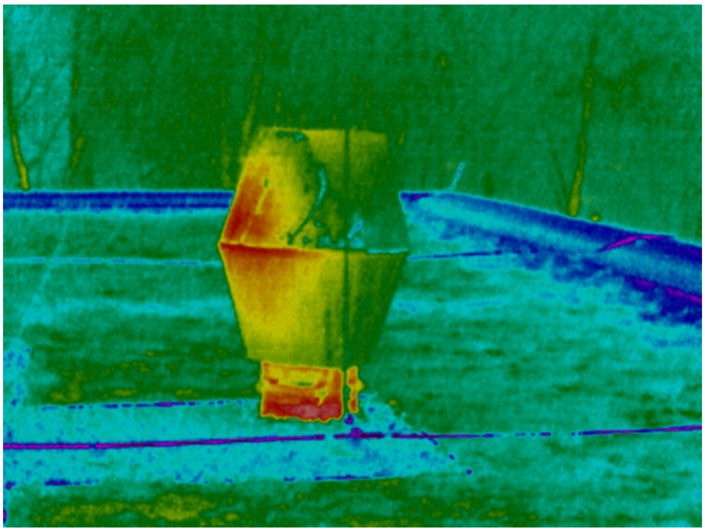

Fig. 1. Thermalvision image of the ventilation system

On the contrary, we can see minimal temperature fluctuations in the surface of the substrate and vegetation. The only minor change is in the area where the aggregate is poured. [Figure 2]

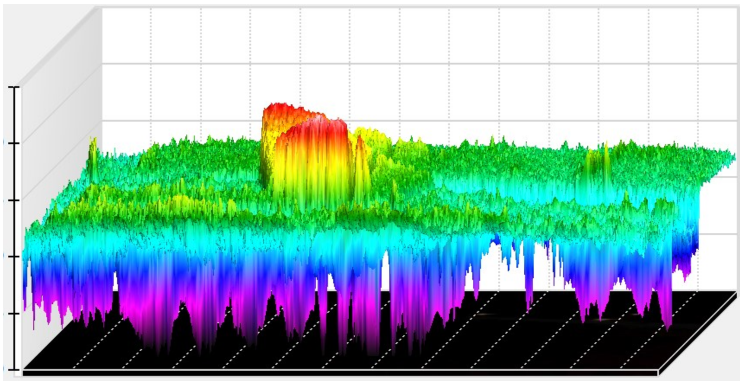

Fig. 2. 3D-IR image of the ventilation system

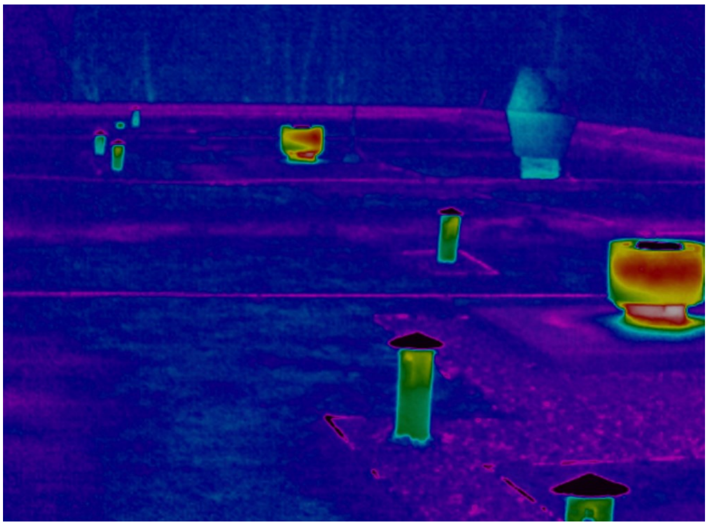

Fig. 3. Thermalvision image of shaft 3D-IR image of the ventilation system

On Figure 3, we can see the temperature differences of the vents of the installations and the surface of the roof. On Figure 4, we can again see the 3D-IR graph of temperatures in the area.

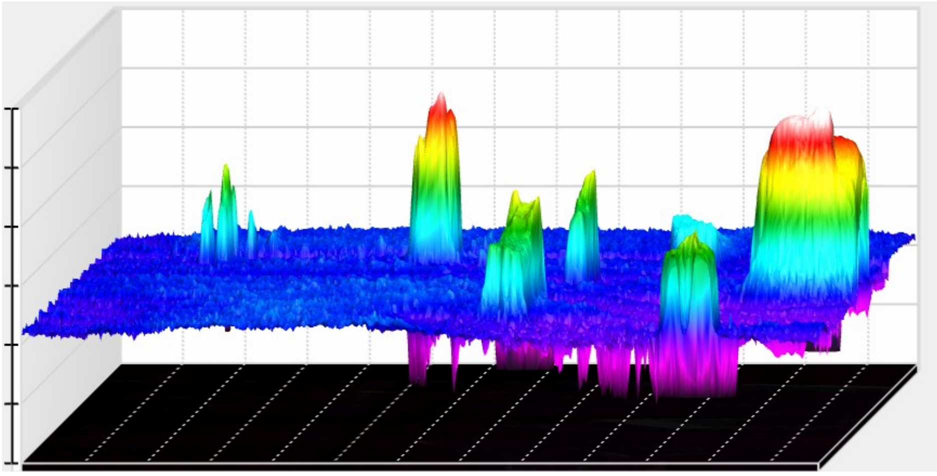

Fig. 4. 3D-IR image of the ventilation chimneys

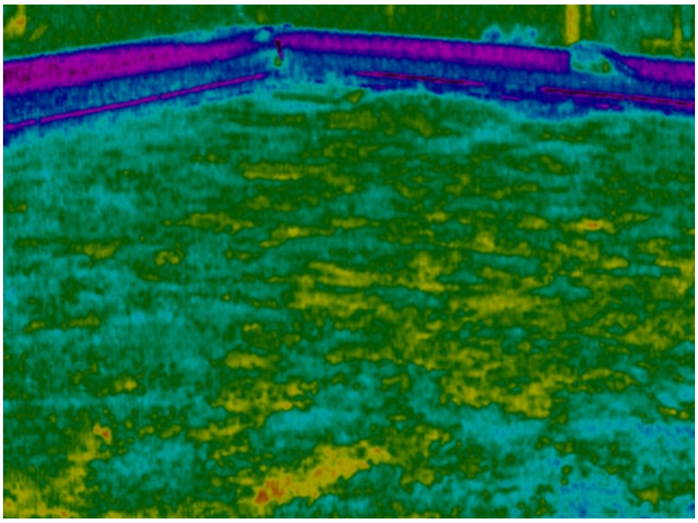

Fig. 5. Thermalvision image of vegetation carpet

The slight differences in the temperatures in the roof surface in Figure 5 were caused by the different thickness of the substrate layer or the partial absence of roof vegetation, even so the temperatures here differed by only 2 to 3°C.

An interesting finding was the measurement of the control segment of the green roof on the Figure 6. It is made of rolled sheet metal and painted with an anti-corrosion agent. However, the implementation in the layers of the roof caused the segment to be almost invisible on thermal images. Small temperature differences are caused by the irregular thickness of the substrate around the segment, as well as inaccuracy during the installation of the hydroaccumulation layer.

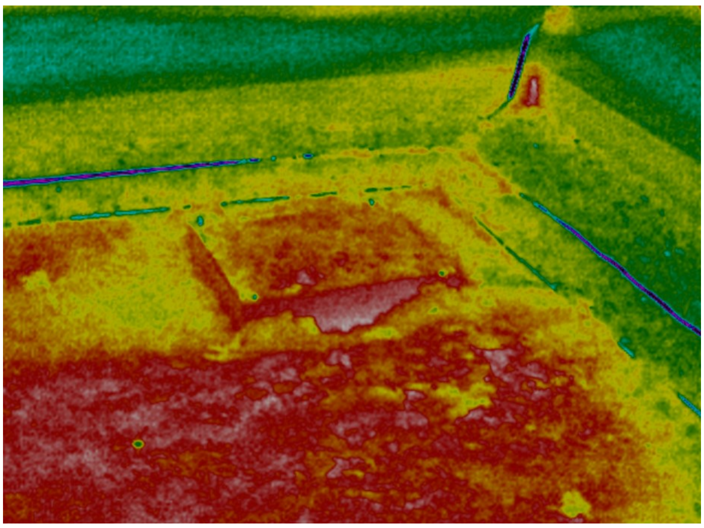

Fig. 6. Thermalvision image of control segment

The control segment therefore has no negative effect on the conduction of heat in the structure and is therefore not a thermal threat or a source of thermal bridges. In this case, the segment is not sufficiently covered with substrate and therefore we can see the square outline of the structure in the picture. In cases where it would be properly sprinkled and lined with hydroaccumulation material, the temperature difference in the surroundings will be minimal.

Measuring equipment

Fig. 7 Thermalvision camera Fluke Ti450

A Fluke Ti450 thermal imager on Figure 7 was used to measure the thermal images and software from the same company was used to export the data from the camera.

Result and discussions

The result of the thermal imaging examination was to determine the state of temperatures in the area of the extensive green roof on the kindergarten building in Brno-Komín. The roof with a vegetated surface showed good thermal technical properties and, apart from the penetrations where the temperature was increased, the roof was thermally balanced and did not show major heat losses.

The second objective was to find out what the surroundings of the control segment look like. In the first mentions of the implementation of the basket, uncertainty was expressed as to whether the control segment would have a negative effect on the thermal technical properties of the roof. Using thermal imaging measurements, we proved that the segment has no negative effects if it is properly built into the structure and is stored at a sufficient depth of the composition.

In general, it can be said that if the vegetation layer is done correctly and the vegetation is sufficiently cared for, the roof really has insulating properties and, among other things, also maintains aesthetic properties.

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