Approaching Near Zero Energy in Historic Buildings

Work Package No: T2

Title: Thermal Imaging Report: Raahe Seminary Rector's House

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Introduction

This document was written in 2022 by Enni Hukka and Ella Korpi of the Oulu University of Applied Sciences, Finland. It was written in support of the thesis by Julia Heinonen titled *Refurbishment and Change of Use at the Rector's House, Raahe: Art Residence Plans and Co-Design Process (2022).*

This version of the document is a translation that was created by processing the text through Google Translate. Historic Environment Scotland (HES) required a translated copy of the thesis and Thermal Imaging Report for the analysis that would inform our writing of Deliverable 3.3.1.

The purpose of this introduction is to confirm that this document is a straight 'digital' translation of the Finnish text with no editing by Historic Environment Scotland or the Energy Pathfinder Project. The translation process was sufficiently effective that the document could be used as a reference work for the Pathfinder project partners but there may be minor errors throughout the document derived from using this process. For example, Google was not able to translate text embedded in images such as the equation on p.5.

Simon Montgomery
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THERMAL IMAGING REPORT

Raahe Seminary Rector's House

Enni Hukka ja Ella Korpi
Spring 2022
Oulu University of Applied Sciences

1. Summary of Thermal Imaging

The purpose of the thermal image study was to find out whether the thermal technical condition.
Thermal imaging refers to determining of a surface and imaging by measuring surface infrared radiation and interpreting thermal images.

1.1 Object

Rector's House, Rantakatu 7, 92100 Raahe
Year of construction 1900

Heating: District heating

The structures of the building are unknown. The building is presumably a log structure based on the time of construction.

Conditions

Outdoor temperature -0.7 ° C

Indoor temperature + 14.1 ° C

Relative humidity 30.6%

Relative humidity 87%

Wind speed: 14.2 m / s

Pressure ratio

Rector's room (1st floor): overpressure 0.3 -3Pa

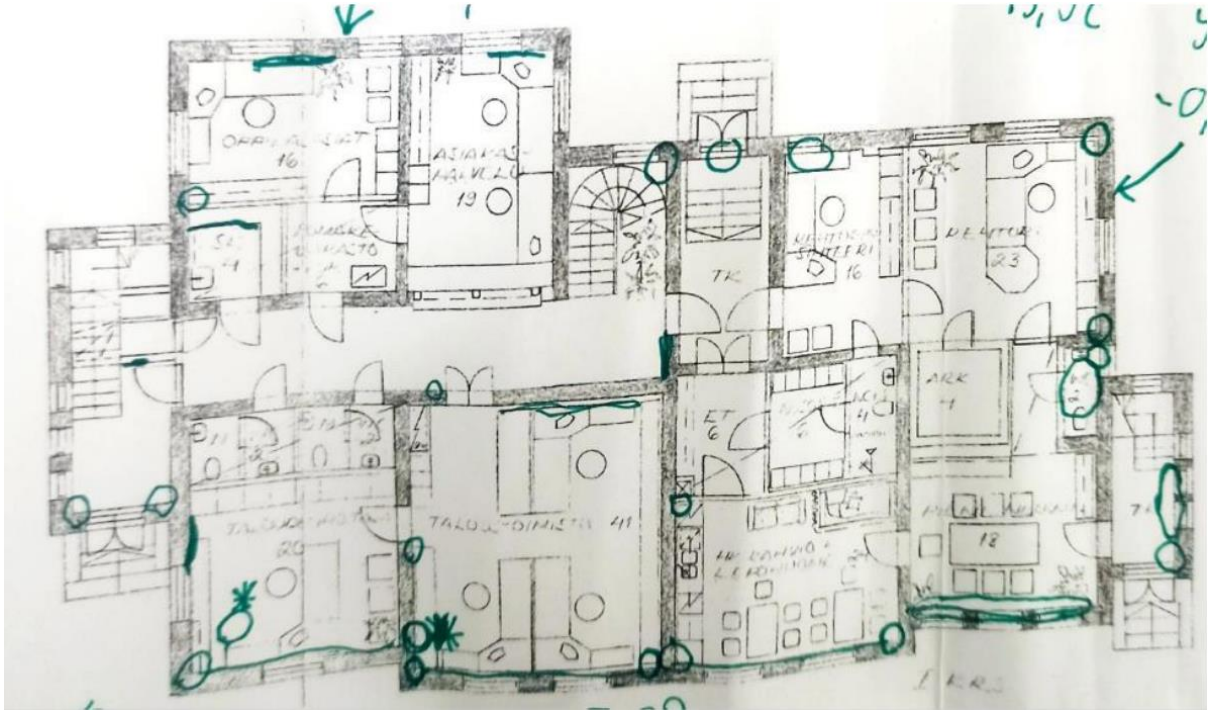
Finance Office (1st floor): vacuum 2.5-6Pa Student Affairs

Room (1st floor): overpressure 3-7Pa

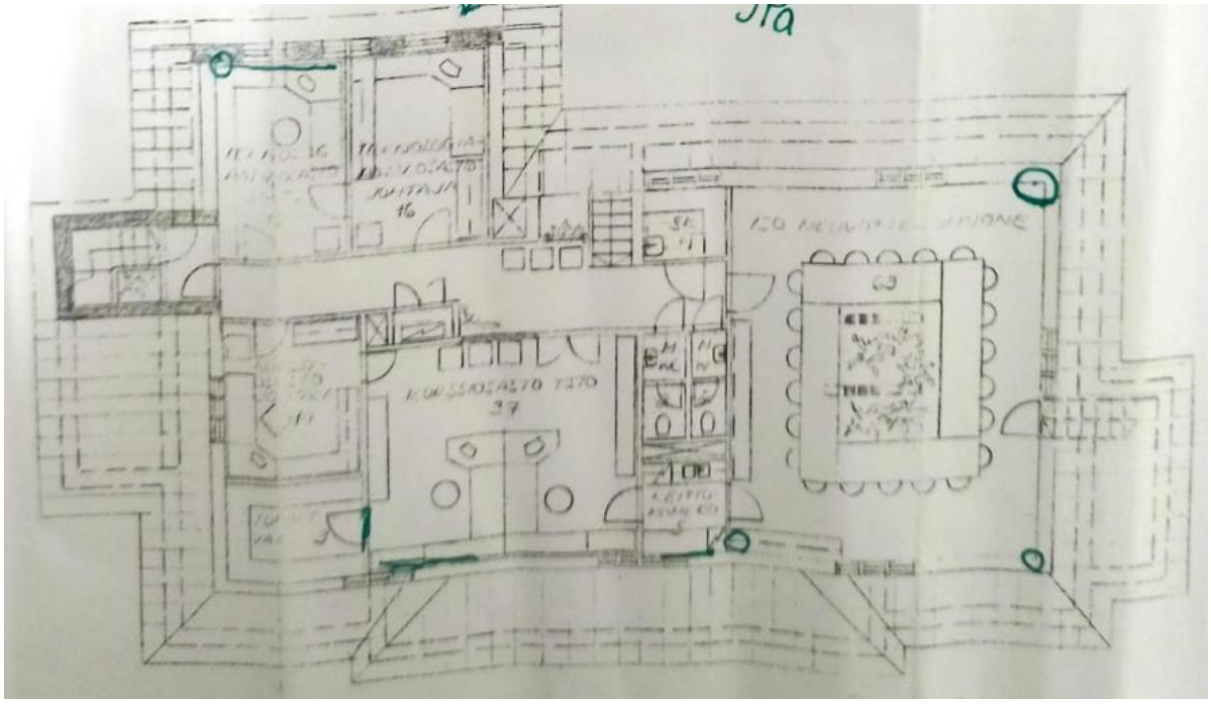
Technical Services Department Manager Room (2nd floor): overpressure 7-9Pa

The windy weather on the measurement day explains the high pressure differences.

First Floor Plan (Thermal imaging locations marked in photographs)



Second Floor Plan.



1.2 Measuring device used.

Thermal camera used: Flir

A thermal imager is a receiver of thermal radiation that measures the intensity of thermal radiation, infrared radiation, emanating from the surface of a subject. The thermal imager converts the temperature of the subject's thermal radiation into information from which the thermal image is digitally generated.

1.2 Temperature index

The temperature index can be used to assess the thermal performance of a building envelope.

Surface temperatures are estimated using a temperature index when temperatures cannot be measured at an outdoor temperature of - 5 ° C ± 1 ° C and at an indoor temperature of + 21 ° C ± 1 ° C. When using the temperature index, the vacuum of the building must be taken into account when the average vacuum exceeds 5 Pa.

Corrective action must be taken if the temperature index is less than 61%.

Lämpötilaindeksin laskentakaava:

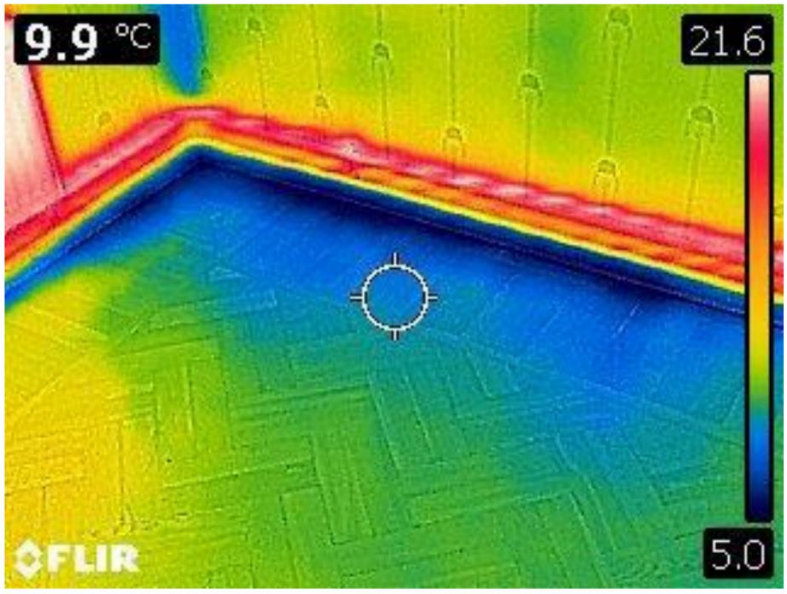
$$TI = \frac{(Tsp - To)}{(Ti - To)} \times 100\%, \text{jossa}$$

TI = lämpötilaindeksi
Tsp = sisäpinnan lämpötila °C
Ti = sisäilman lämpötila °C
To = ulkoilman lämpötila °C

2. Thermal images

Status 1st floor Rector's room

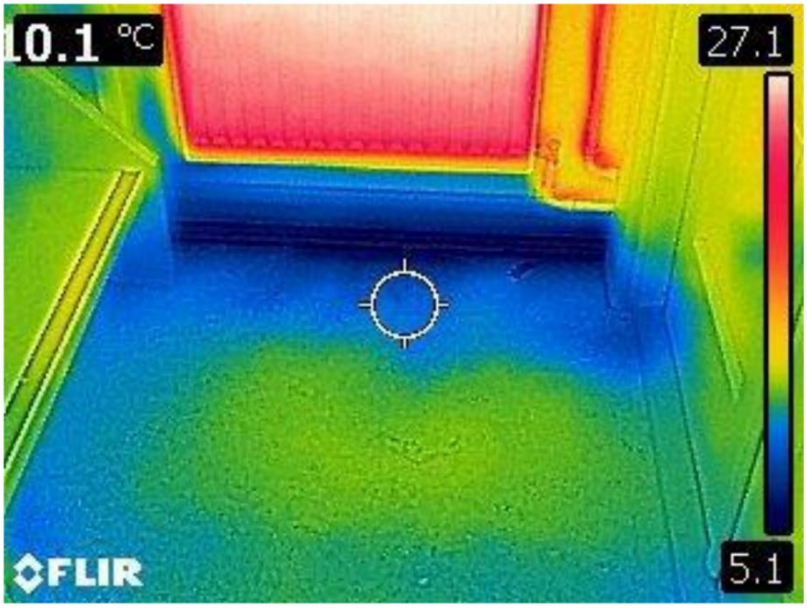
Comments: Heat leakage can be observed in the room through the lower floor. **Point temperature** 9.9 ° C
Range min. 5 ° C
Temperature index TI 39%
Pressure: overpressure 0.3-3Pa



Volume: 1st floor, staircase/second entrance

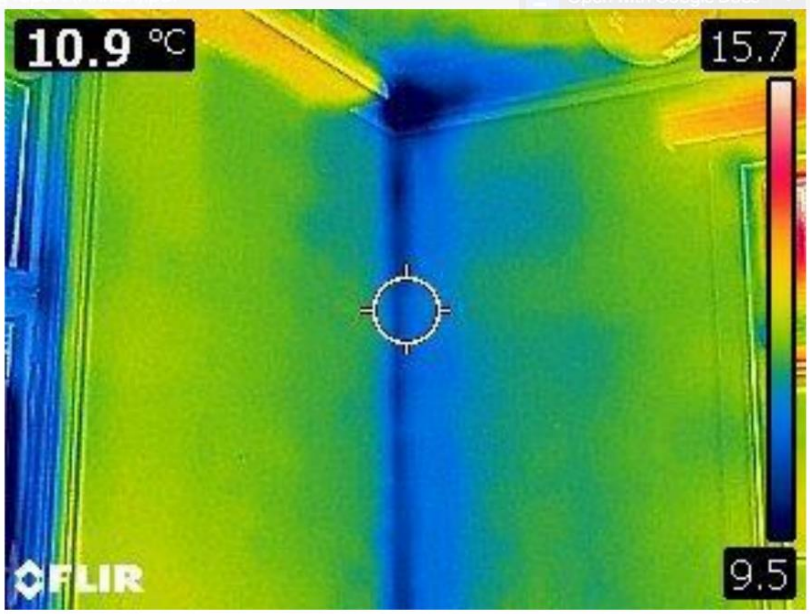
Comments: Heat leakage in the room through the lower floor.
Point temperature 10.1 ° C
Range min. 5 ° C

Temperature index TI 39%



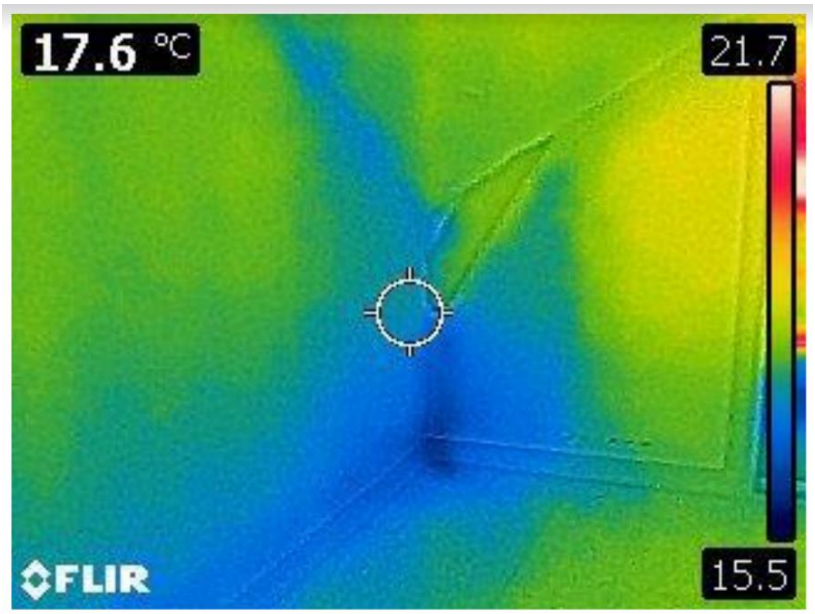
Status 1st floor Room

Comments: Heat leakage can be observed in the room through the junction of the walls. **Point temperature** 10.9 ° C
Range min. 9.5 ° C
Temperature index TI 69%



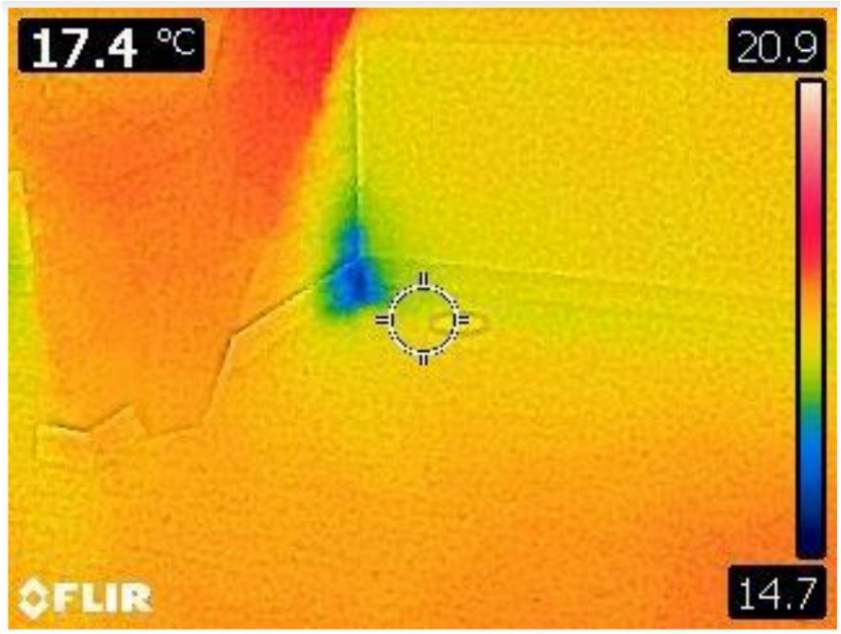
Status 2nd Floor large conference

Comments: Some heat leakage can be observed in the room through the junction of the walls and the midsole.
Point temperature 17.9 ° C
Range min. 15.5 ° C
Temperature index TI 109%



Status 2nd floor Large conference

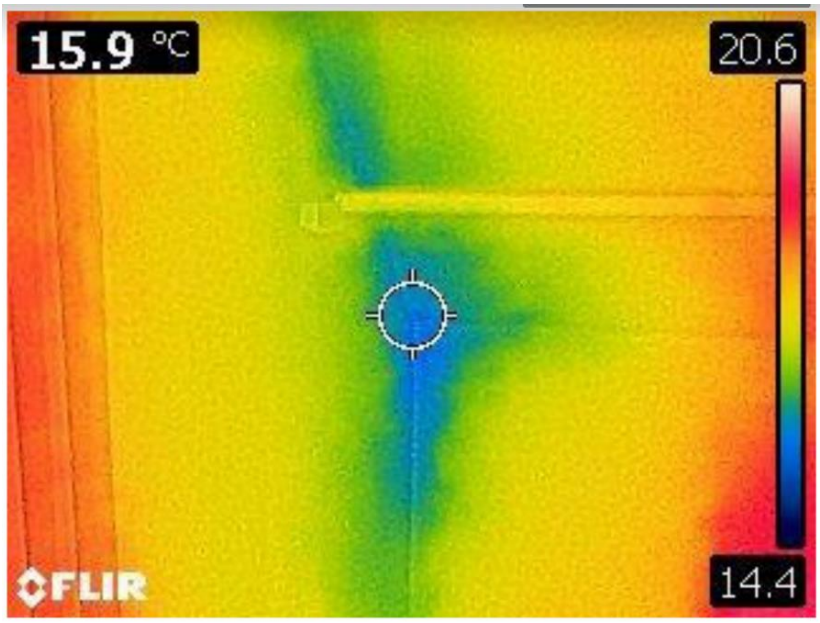
Comments: Heat leakage in the room through the midsole.
Point temperature 17.4 ° C
Range min. 14.7 ° C
Temperature index TI 104%



Status: 2nd floor room

Comments: Slight heat leakage in the room through the upper floor.
Point temperature 15.9 ° C
Range min. 14.4 ° C

Temperature index TI 102%



Status 1st floor Room

Comments: There is heat leakage in the room in the middle of the wall.
Point temperature 15.8 ° C
Range min. 14.7 ° C
Temperature index TI 105%
Pressure vacuum 2.5-6 Pa

3. Summary of Measurement Results

Heat leakage through the lower floor was observed throughout the first floor. Cold bridges were observed at several floor corners as well as at the junctions of the walls.

In the first two figures, the temperature index is less than 61% (39%), ie corrective action is required at those points. The alternative is, for example, additional thermal insulation or the replacement of damaged structures with new ones, if possible.

High overpressure differences due to windy weather affect the results of temperature imaging and the reliability of the temperature index.