THERMAL IMAGING REPORT
LSHP Administration building

22.3.2018

Lapland UAS

Niko Pernu, Olli Kuisma, Michael Tirroniemi

Basic information of property & background

Background

Thermal imaging of buildings is conducted to locate thermal bridges and leakage spots, which waste heating energy. Air leakages may have dramatic effects on thermal comfort of a space, lowering temperatures and creating draft. In this study, goal was to locate leakages and also to verify effects of renovations regarding indoor climate comfort and energy efficiency.

Subject of this study, the administration building of Lapland hospital district has been thermally imaged in 2011. By combining results of these two studies, we can analyze the concrete impacts of energy efficiency renovation conducted during 2017 – 2018. Comparison makes possible to verify quality and effectiveness of renovations.

Building

Three-story building was built in 1975. Floor area is 3346 m^2 and heated volume 8 480 m^3. Building's frame is concrete with limestone brick façade. Larger renovation was performed during 1989, and smaller, more space-specific renovations ever since. Buildings entrances A & B were equipped with wind boxes, and windows and doors were replaced with energy efficiency in mind. These actions have drastically improved quality of indoor climate and thermal comfort in upper floors.

Rest of windows and doors were replaced in 2012 & 2013. During 2017 & 2018 energy efficiency measures were done, this time focusing on structural energy efficiency. Additional insulation was installed, thermal bridges eliminated and structure joints airproofed.

Site visit & imaging process

Site visit was performed in two separate occasions, during 19.3.2018 & 22.3.2018. First visit was mainly introductional visit with construction engineering students, demonstrating characteristics and guidelines of thermal imaging. Actual thermal imaging was performed during second visit, following a plan made in advance. One of the main goals was to produce data that would be comparable with data from 2011.

Process of thermal imaging contains much more steps than just taking thermal images. Measuring the indoor- and outdoor conditions is crucial when it comes to actually interpreting the thermal images. Outdoor temperature was – 2.5 C° and relative moisture was 85 %. Wind was blowing from east at 1 meter per second. Indoor climate parameters were recorded between 19 – 20.5 C° and 72 % RH. Pressure difference over the building envelope was - 7.5 Pa.

Equipment used

Thermal imaging was performed with Fluke TiR32 device. Outdoor- and indoor temperature and moisture was measured with Fluke 975. The pressure difference over the building's envelope was analyzed by using Swemaman 60. Wind speeds were recorded using AirFlow LCA501.

Limitations

Since goal of this thermal imaging was to examine and analyze the impacts of energy efficiency measures done during 2012-2018, we decided to focus only on areas where deficiencies were noted in the thermal imaging conducted in 2011. Rest of the building was thermally imaged only during 19.3.2018 with students on demonstration and education purposes. No flaws or defects were noticed in process.

Basic property information

Administration building of Lapland hospital district

Property: Administration building

Address: Porokatu 39

Zip code & city: 96400 Rovaniemi

Purpose: Administration building, hospital school

Built: 1975

Renovated: 1989

Building volume: 8480 m^3

Area: 3.346 m^2

Conducted studies:

- Thermal imaging 2011
- Energy assesment 2012 - 2013

Summary of thermal imaging

Windows

In 2011, most of flaws reported focused on window structures and ventilation windows. Varying air leaks were common, resulting in discomfort and risk of condensation. Windows have been replaced since, which was clearly visible immediately after starting up the thermal camera. Air tightness has been significally improved. Minor defects were noted during 2018 imaging, but despite those, situation was much better when compared to 2011 report. Windows play a huge role in air tightness, and there's no doubt conducted renovations have reached their goal.

Doors

This thermal imaging focused only on balcony doors, most of them placed in offices. In 2011 multiple doors did have significant air leaks that took mainly place at the bottom of balcony doors. Leaks lowered surface temperatures of door itself, but also surrounding structures noticeably. After 2011, balcony doors have been replaced and air leaks are no longer present

Structures

Structural energy efficiency of wall structures was under the scope only in room 228, since report from 2011 did not mention that any other space would have deficiencies regarding thermal properties of walls, floors or roof structures. One, clearly visible thermal bridge was still present in room 228, but it does not affect the thermal comfort, thanks to added insulation layer on the wall. Thermal bridge is due to balcony structures. Balcony does not exist anymore, but some inconsistencies are still within the wall structure.

Summary

Overall the energy efficiency measures have been a success. Problems detected in 2011 have clearly been noted and tackled, and renovations have eliminated most of the air leaks and other thermal defects. Effects of known thermal bridges have been minimized. Energy efficiency of the building has been improved, in addition to increased indoor climate comfort and thermal functionality.

Thermal imaging results by each room

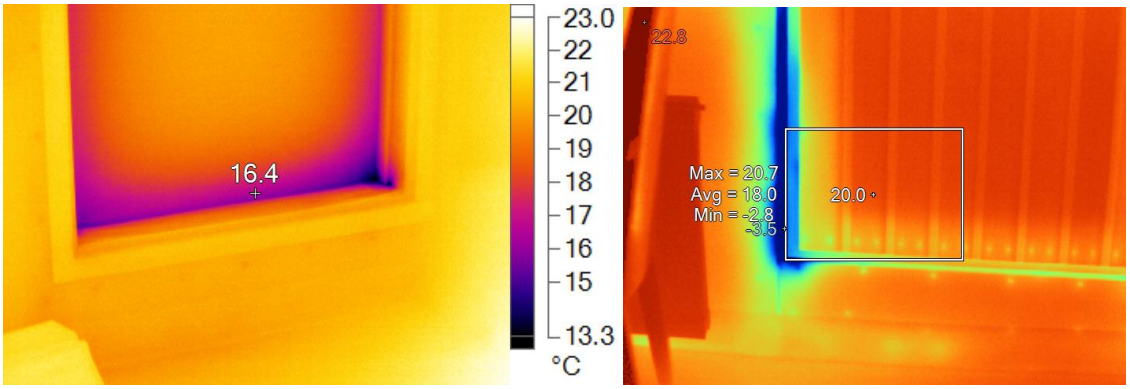
Thermal images shown below were captured from almost identical angles and spots to be as comparable as possible with thermal images from 2011. This gives wide range of possibilities when it comes to comparing and verifying the renovations and energy saving measures conducted between the two thermal imagings. Current state of administration building is shown below in the actual photograph and left-hand side thermal image. Thermal image on right side is placed on the right. Pictures have been categorized by each room.

Thermal index was calculated for thermal images of current state. Thermal index is mainly used to evaluate indoor climate comfort and thermal functionality of a building. Current living health code defines, that when indoor temperatures differ from national standards, an analysis based on thermal index is conducted. Thermal index must be over 61 %, or otherwise immediate measures are required to eliminate discomfort and structural deficiencies. Thermal index is calculated by using temperature of a spot in addition to outdoor- and indoor temperatures and pressure difference over building envelope.

4-class evaluation system is also widely used in addition to national guidelines, although the lowest rating (61 %) is equal to the one in living health code. With 61 % TI structure is defined as “requires maintenance”. All thermal indexes between 61 – 65 % are classified as “decent”. Structures meet the minimum requirements of thermal comfort, but may have deficiencies in thermal performance. Third class consist of TI values of 66 - 69 %. Best and final class is achieved with TI value of 70 % or above, which grades structure thermally good.

Room 138

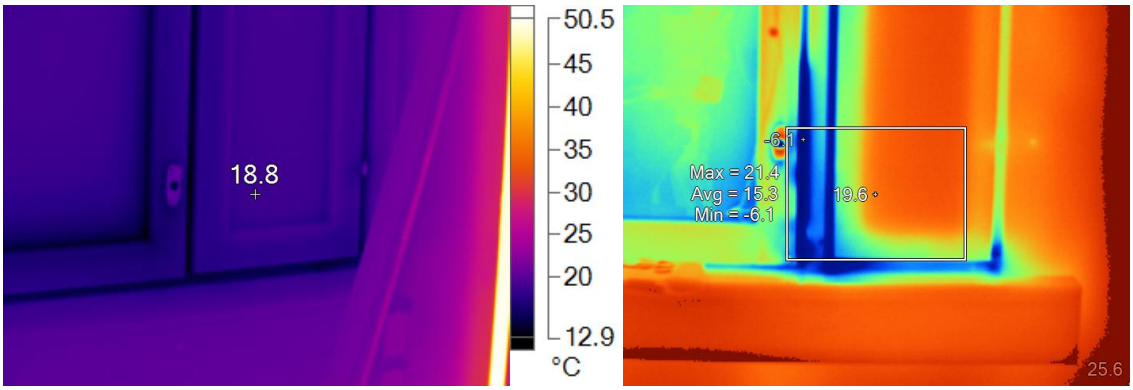
Some changes in room structures has been made after 2011, but we were able to locate the same balcony entrance despite that. Door has been replaced and it has enormous, positive impact on thermal properties and comfort.



Thermal index of the lowest temperature recorded at current state is 70 % - Good.

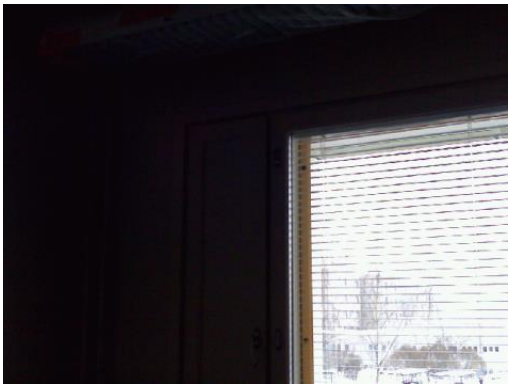
Room 145

Window has been replaced, which took care of great air leaks documented in 2011. Since air leaks are no longer present, surface temperatures are considerably higher now.

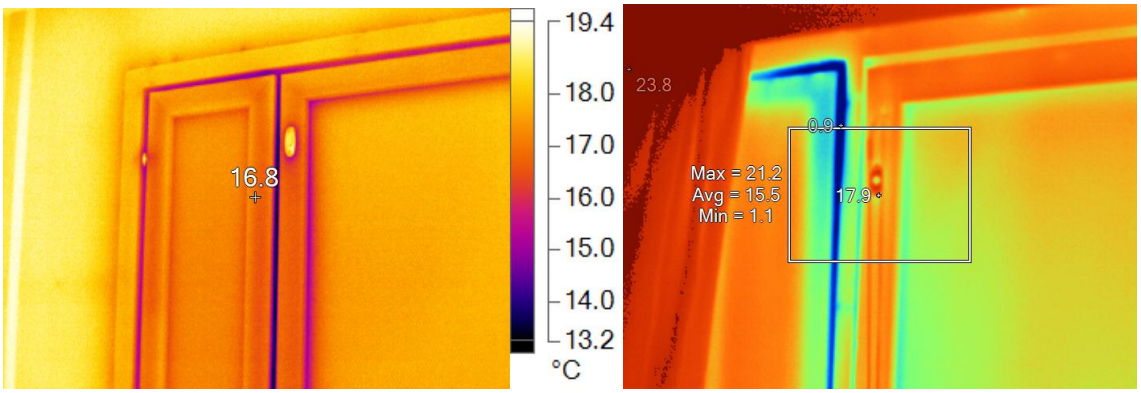


Thermal index of the lowest temperature recorded at current state is 73 % - Good.

Room 163



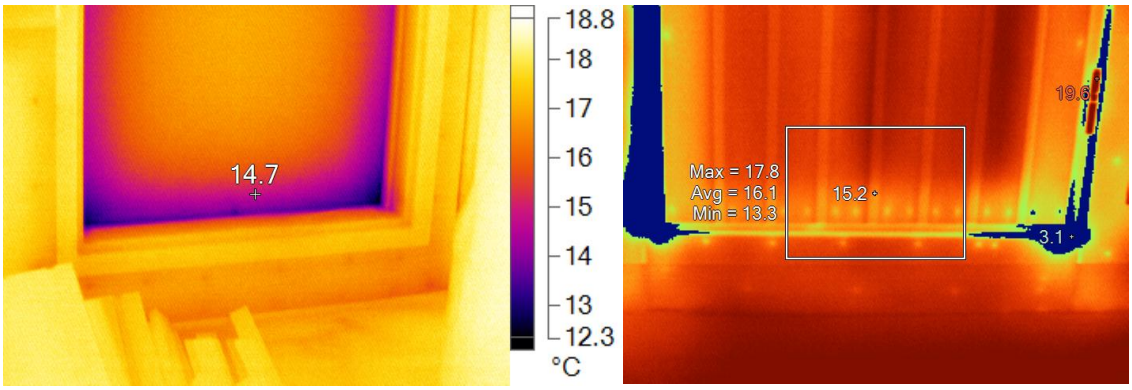
Since the window has been replaced, air leaks are no longer present.



Thermal index of the lowest temperature recorded at current state is 75 % - Good.

Room 163

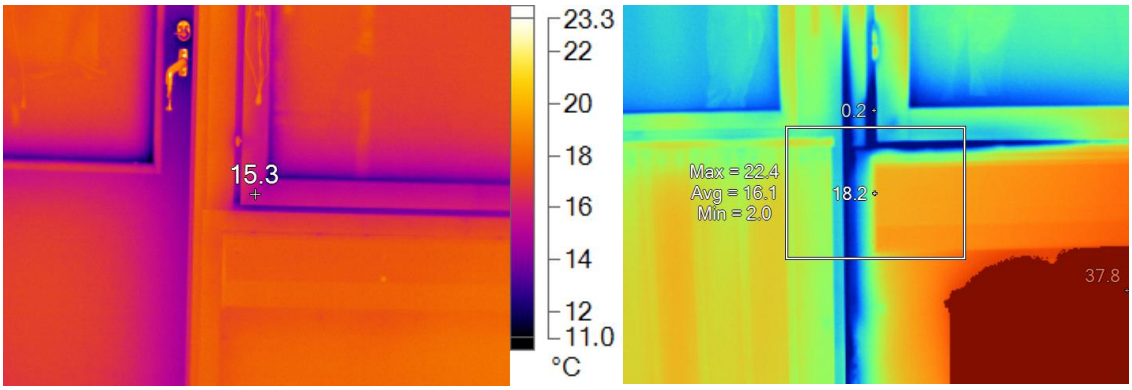
Almost freezing temperatures measured in 2011 have been eliminated completely with new balcony door.



Thermal index of the lowest temperature recorded at current state is 70 % - Good.

Room 165

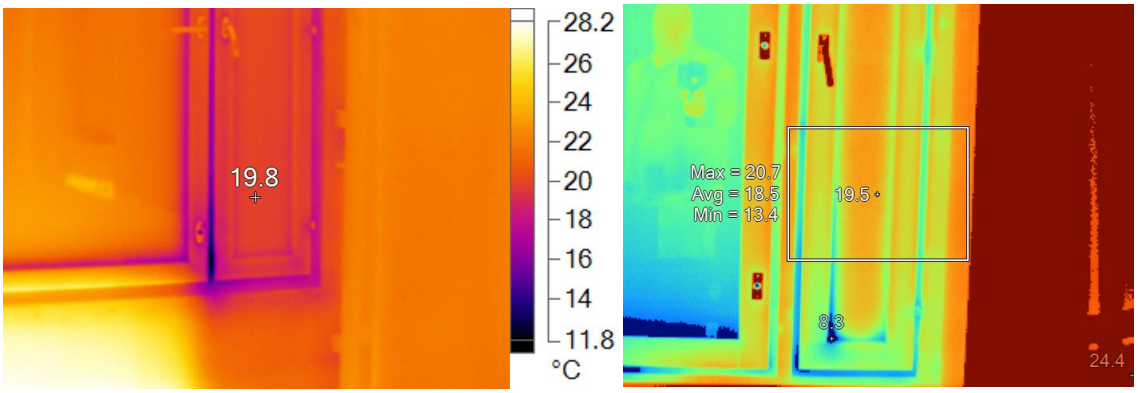
Room 165 was diagnosed with enormous air leaks between balcony door and window structure. At a current state, problem is no longer present and thermal properties are good.



Thermal index of the lowest temperature recorded at current state is 74 % - Good.

Room 173

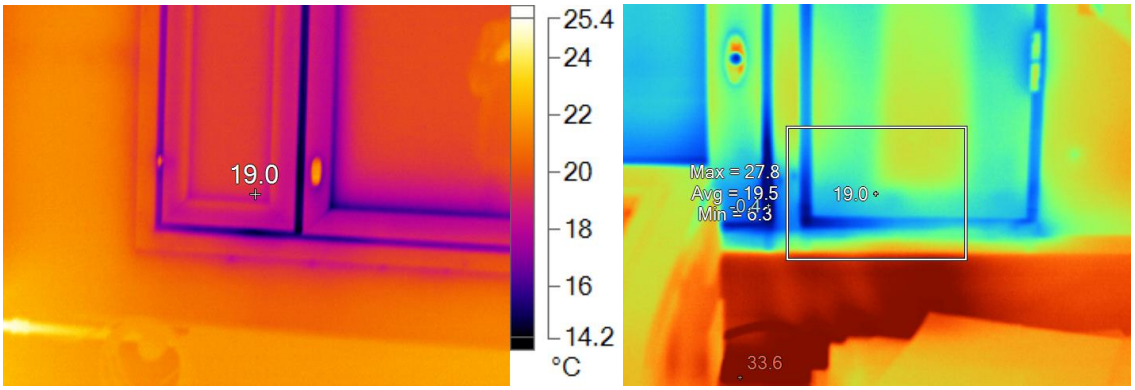
Ventilation door in conference room still has a minor air leak at the bottom left corner. Although thermal impacts are clearly visible, the problem itself is likely easy to fix with a new seal.



Thermal index of the lowest temperature recorded at current state is 64 % - Decent.

Room 201

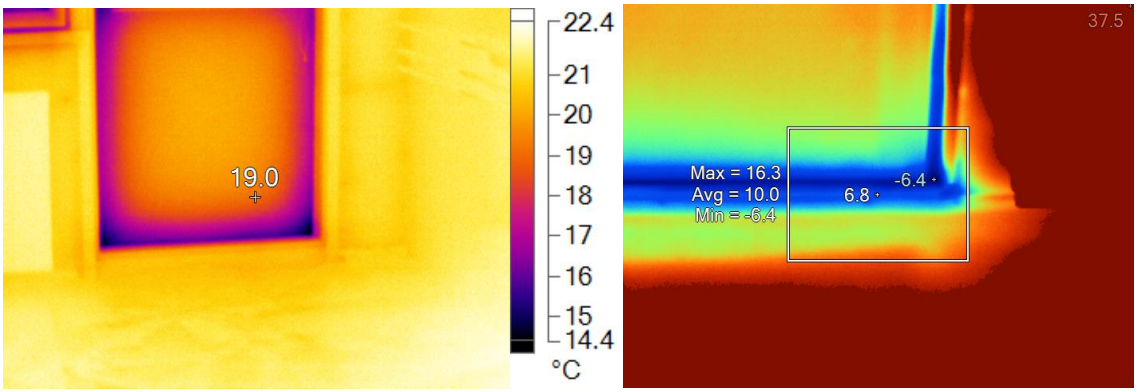
In room 201, the ventilation window has been replaced and has switched from left to right during renovation. New window has no noticeable air leaks.



Thermal index of the lowest temperature recorded at current state is 76 % - Good.

Room 201

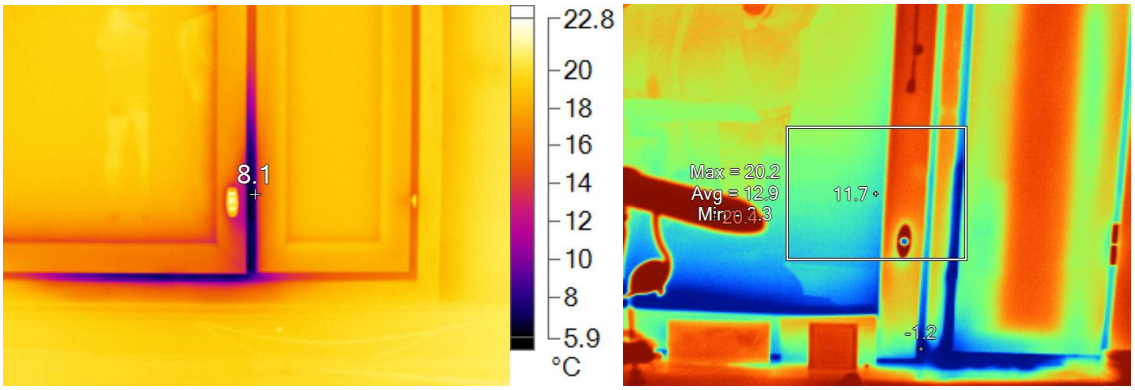
Balcony door has been replaced and now has better air tightness, resulting in better thermal comfort.



Thermal index of the lowest temperature recorded at current state is 77 % - Good

Room 204

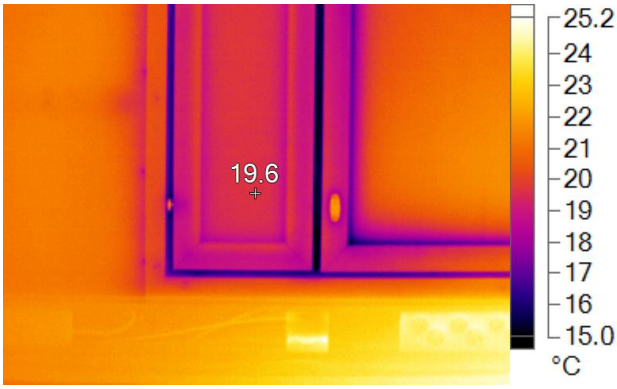
In room 204, air leakage was present and almost identical to the one documented in 2011. Thermal index of window structure is very poor. Maintenance is required to avoid thermal discomfort and further structural damage.

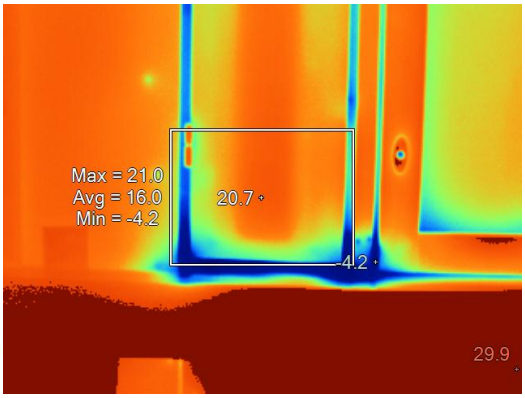


Thermal index of the lowest temperature recorded at current state is 39 % - Requires maintenance.

Room 208

Ventilation window has noticeably better air tightness when compared to the situation in 2011. There were no extremely low temperatures present in 2018.

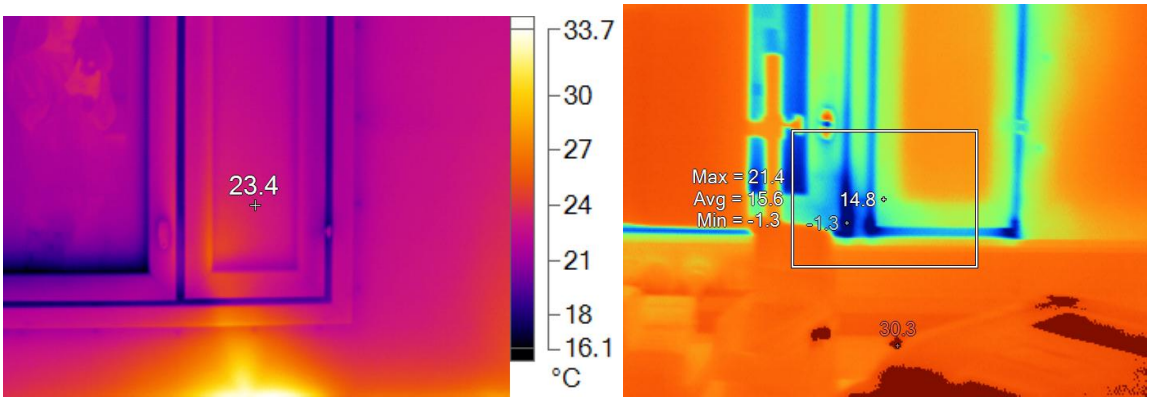




Thermal index of the lowest temperature recorded at current state is 78 % - Good.

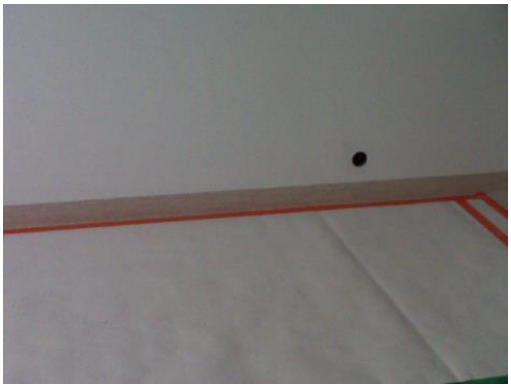
Room 225

Problematic air leak was solved by changing the window structure.

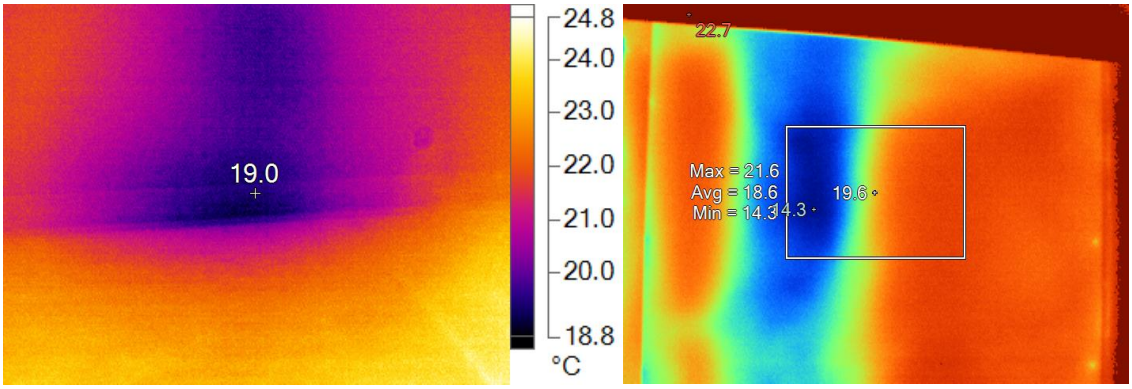


Thermal index of the lowest temperature recorded at current state is 84 % - Good.

Room 228

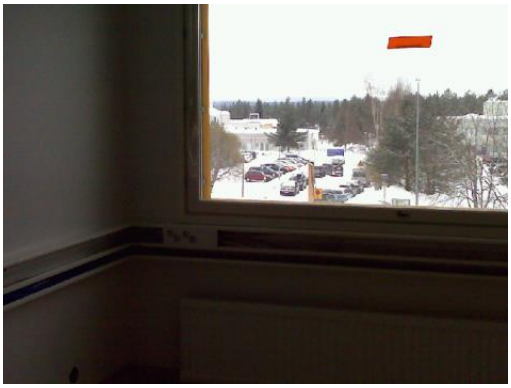


The remnants of an old balcony structure forms thermal bridge. In current state, added insulation keeps the wall temperature in good values, thanks to added insulation.

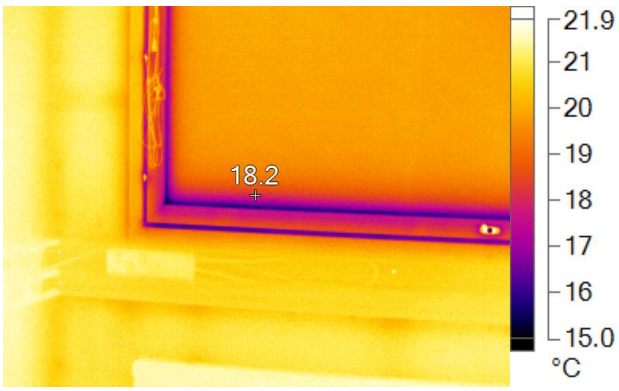


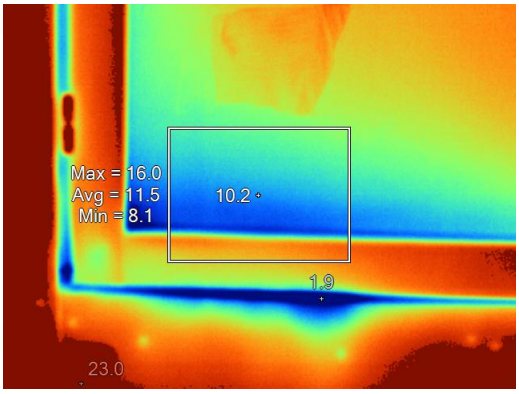
Thermal index of the lowest temperature recorded at current state is 94 % - Good.

Room 238



Problem regarding the great air leakage thermally imaged in 2011 has been solved by changing the window structure.

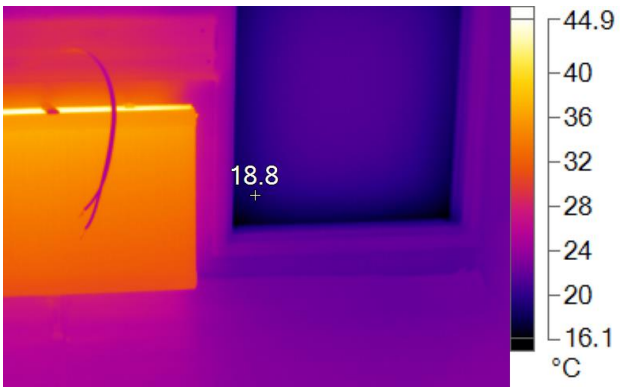


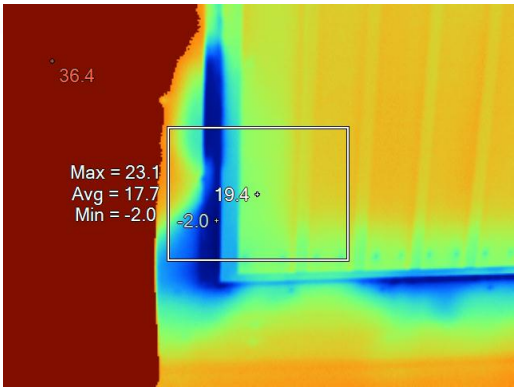


Thermal index of the lowest temperature recorded at current state is 78 % - Good.

Room 255

Replaced balcony door has eliminated the strong air leakage.

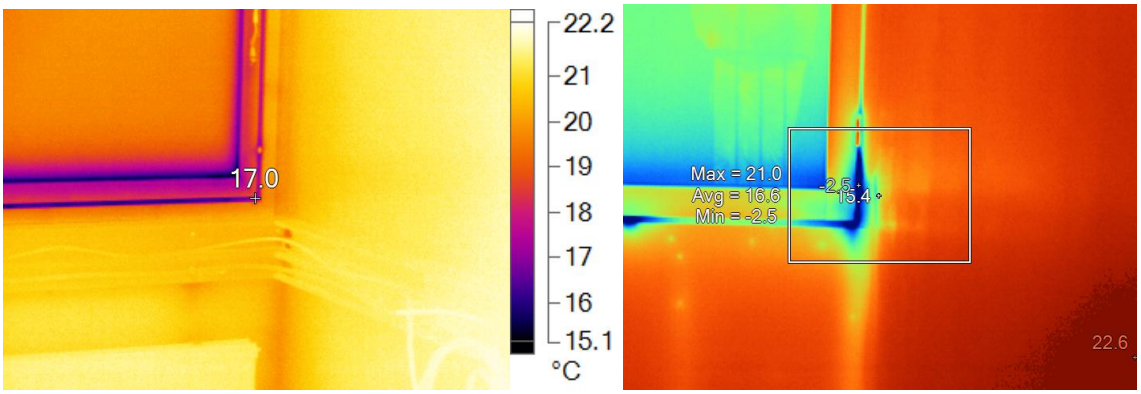




Thermal index of the lowest temperature recorded at current state is 84 % - Good.

Room 260

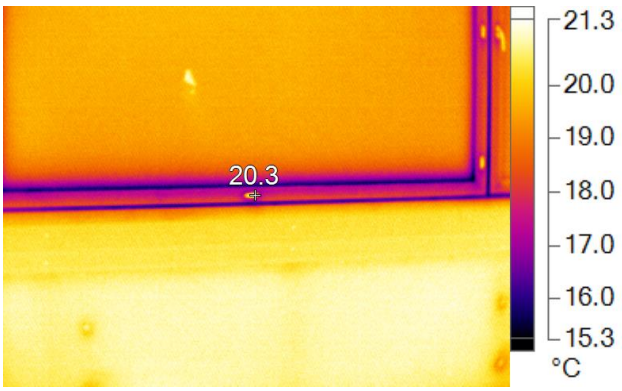
Replaced window in room 260 has improved thermal comfort greatly. There was no air leaks to be found, and overall temperature in and around the window is higher than in 2011.

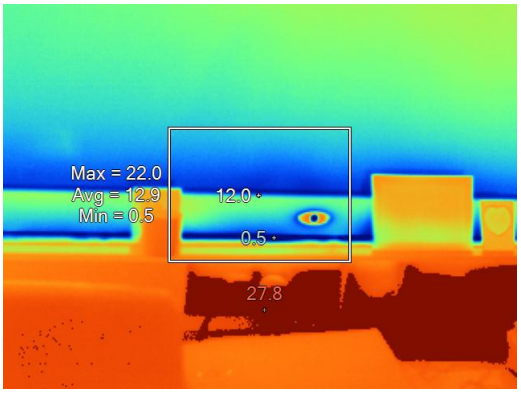


Thermal index of the lowest temperature recorded at current state is 80 % - Good

Room 274

Temperature of the window structure was warmer in current state, and no noticeable air leaks were found.





Thermal index of the lowest temperature recorded at current state is 79 % - Good.