ADMINISTRATION BUILDING LPSHP

Energy audit

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A summary of the energy economy of the site and the proposed improvements

Site details

Property: LPSHP Administration building

Address: Kauppakatu 25, 94100 Kemi

Building type: Office building

Construction year: 1954

Renovated: 1994

Building volume: 3500 m^3

Energy consumption

Since building has no active consumption monitoring of heating energy or electricity, it is simply impossible to define building's current energy consumption and energy saving potential of proposed actions. Consumption levels of this building are estimations based on simulations, measurements and statistics collected from similar buildings.

In table 1, reference building consist of public office buildings. Electricity consumption is slightly below median of reference buildings. Water consumption is quite high in administration building, but is partly explainable by usage of sauna spaces located in basement floor.

	Estimated consumption	Estimated	

		specific consumption	Median of reference buildings
Heating energy	350-550 MWh	100-157 kWh/m^3	41,9 kWh/m^3
Electricity	64 MWh	18,2 kWh/m^3	19,3 kWh/m^3
Water consumption	380 m^3/a	109 dm^3/rm^3	61 dm^3/rm^3

Table 1: Summary of estimated energy consumptions.

It is difficult to estimate consumption of heating energy due to uncertainties regarding use hours of ventilation systems and air tightness of building envelope. Insulation thickness of attic floor is impossible to determine without deconstructive measurement methods. Even on most optimistic starting values, the energy consumption is over 300 MWh each year. Noticeable energy savings are achievable by these actions:

Heat

- Monitoring of heating energy consumption
- Balancing of ventilation system
- Eliminating air leakages
- Heat recovery ventilation (HRV)
- Insulation of heatpipe and ventilation channel

Electricity

- Monitoring of electricity consumption
- Adjustment of supply air temperature

Water

- Active water consumption monitoring

Current state of energy use of the site

Energy and water supply

Heating energy and usage water is brought to the administration building from areal heating network via hospital building's heat exchanger. Building does not have a sub measurement for heating energy.

Picture 1: Sub distribution center

Description of the heating system

Heat distribution is performed by water-heated radiators in rooms and ventilation system. Radiators and thermostats located in office spaces are in good shape.

Radiators' temperatures were measured during the audit. Highest measured temperatures were 59 °C, and temperature of heated, flowing water was 62 °C. Heat pipe runs through structures and office spaces mostly without insulation, which causes high room temperatures in some rooms.

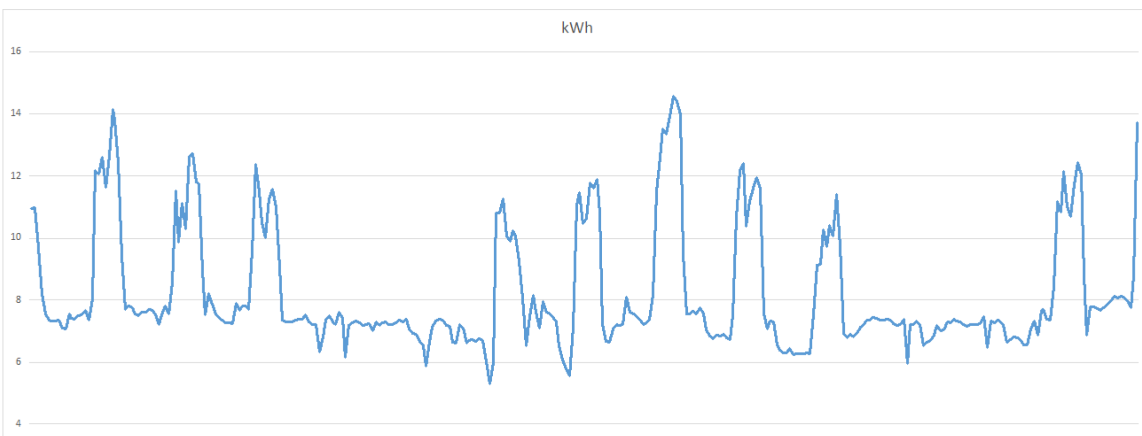
Picture 2: Non-insulated heat pipe in corridor 103.

Room temperatures were on a good level when it comes to energy efficiency (20 - 22 °C), but during measurement period, the temperatures dipped to 17 °C in some rooms for days' period.

Electrical system

Building does not have submeasuring for electricity, which forced us to conduct measurement by 2-week measurement period directly from the riser. Current of all three stages and ground were measured in 5-minute intervals.Average power of 5-minute period was calculated from measured values. From that value, the consumed electricity was calculated with using power equivalent (cosϕ 0.7). Estimation is based on the amount and type of electrical equipment in building.

Annual electricity consumption was achieved by multiplying calculated 2-week energy consumption by 26 and multiplying the result with 0.9 to compensate the lower electricity consumption during summer months. Calculated annual electricity consumption of property is 63.78 MWh.



Picture 3: Hour consumption data of electricity in 15. - 29.1.2019.

Hour consumption of administration building represents typical office building. Consumption peaks are, not so surprisingly during office hours, and base load created by ventilation, pumps and electric heaters, is quite stable during nights and weekends.

Base consumption 7.5 kWh

Peak consumption 14.5 kWh (Both measured on Wednesdays)

Water and sewage systems

Flowrate of water equipment was measured with Oras measuring cup. Bathroom faucets' water flow was 10 – 13 l/min and rec rooms 17 – 18 l/min flow, which is slightly above ideal level. Water consumption of 380 m^3 is quite high for an office space, but explained by usage of sauna spaces. No leaking water equipment was found during audit.

Ventilation system

Ventilation of western wing is carried out by floor-specific HRV-systems. Controls of systems are conveniently located near system itself. Systems do have slightly lower volumes of supply air, which creates vacuum within the building.

Floor	1	2
Out	-3°C	-1°C
Supply	21°C	24°C
Exit	21°C	17°C
Waste	6°C	3°C

Table 2: Temperatures of ventilation system.

Temperature of second floor's supply air was noticeably high, and exhaust air temperature was quite low. Traditionally exhaust air temperature matches room temperature, which implies that some of the air ducts are exposed to elements on their way to the ventilation machine. Insulation of ducts is recommended.

Deekax talteri DIVK-C220

- Supply fan: 520 W
- Exhaust fan: 520 W
- Pre-heat resistor: 1000 W
- Post-heating resistor: 1000 W
- Maximum volume 220 l/s
- Annual electricity consumption 19 MWh/a
- Energy saving potential 11 MWh/a
- Bought energy 8 MWh/a

Ventilation of eastern wing is carried out by HRV-systems located above attic floor. Ventilation machine serving 1st floor has supply air flow of 75 l/s, set to 23 °C. Ventilation needs adjustment. Some of the terminal devices are located poorly, guiding supply air flow to hit user directly. This causes feeling of draft, and some of the users had implemented DIY solutions to guide airflow away from them.

Negotiation room had plenty of terminal devices, but ventilation is still insufficient. During measurement period, CO2 levels reached measurement equipment's maximum values of 2000 ppm, which is clearly over all guidelines.

Picture 4: Supply air flows directly towards extract valve.

Ilto 800 405

- Fan power 820W
- Heating resistor: 1500W

Meeting room in basement has it’s own ventilation machine. Air flow volume of machine was massive during audit, 2,5-3 m^3/s. Air volume is considered excess in relation to the size and use of the spaces.

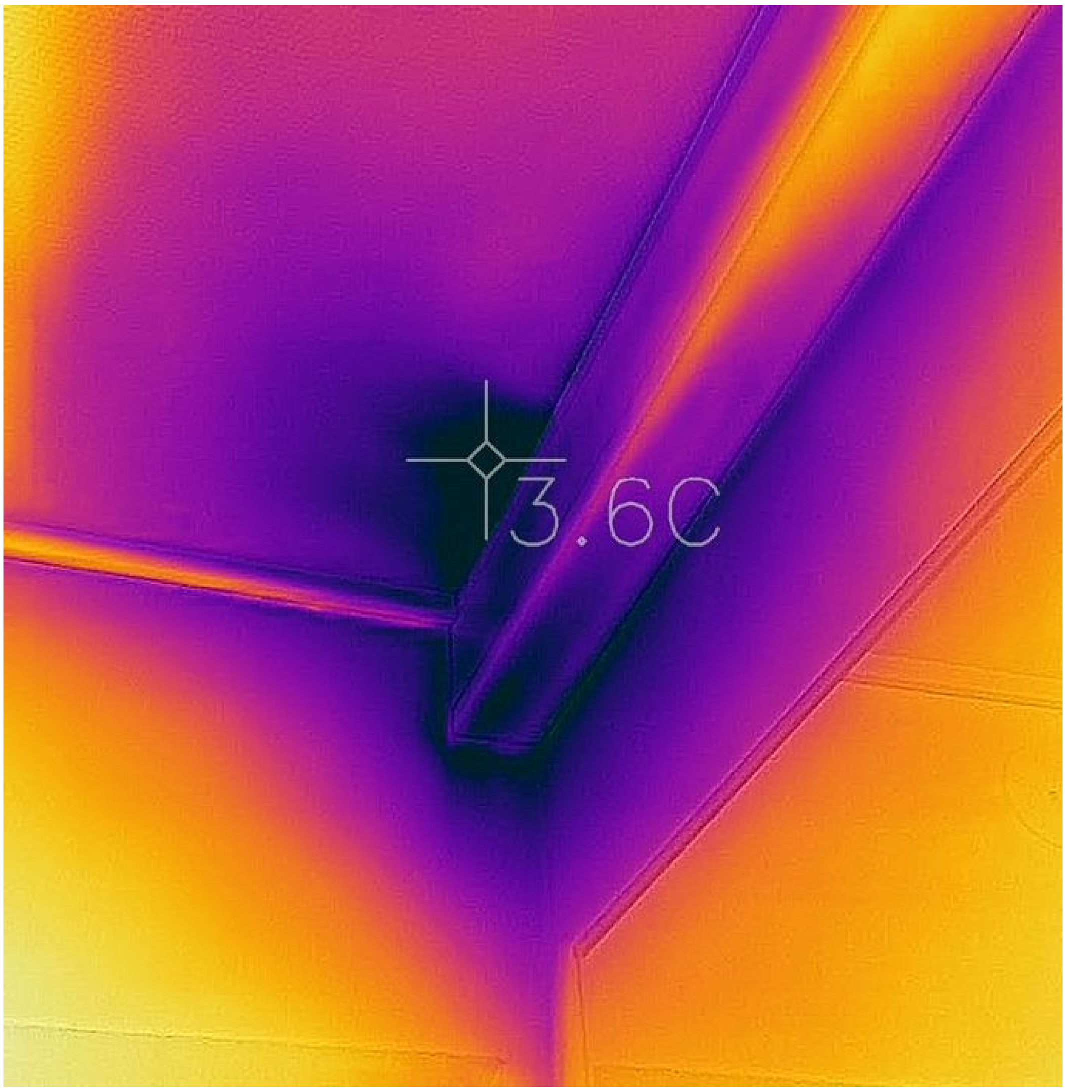
For example, heating 2,5 cubic meters in second to 20 degrees warmer requires 60 kW of power from heating resistor.

Cooling system

Meeting room in basement has air circulation system with heating and cooling capability. Power of heating is 4,42 kW and cooling power is 6,24 kW. Outer unit of the system is on southern side of the building.

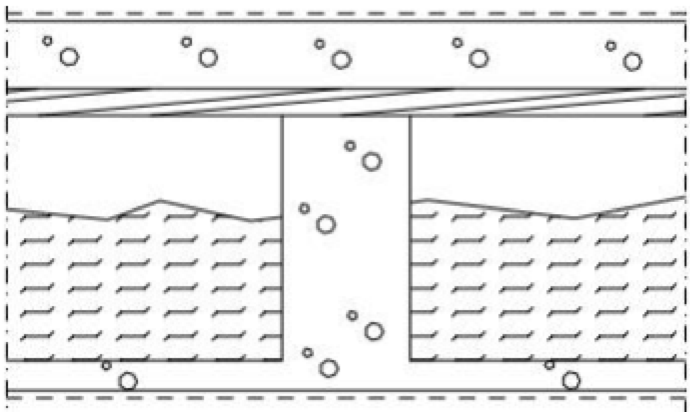
Structures

Thermal imaging (Flir One Pro) and surface temperature measurements were done during the audit. Vacuum in building causes uncontrollable airflow to building via unsealed passages and ducts. These cause very low surface temperatures during winter months.



Picture 5: Cable passage.

Wall structure is typical to era; massive brick structure 1½ bricks thick with 50 – 100mm of insulation inside. Subfloors and attic floor are twin slab structures, 500mm thick. Insulation of twin slab has usually consisted of organic materials, such as wood chip. Windows were in good shape and no leaks were spotted.



Picture 6: Twin slab structure

Proposed actions

Heating system

If building’s air tightness, thermal leaks or ventilation system will be repaired or altered, radiator system should be adjusted. Adjustment of radiation system should always be performed as a last action to achieve maximum savings.

Ventilation system

Building’s ventilation is unbalanced and creates vacuum within the building, which causes cold airflows and surface temperatures via passages throughout the building. Some of the indoor air-related symptoms may be caused by impurities coming through the unsealed passages.

- Balancing of ventilation

Most of the air leaks could be eliminated by adjusting supply and exhaust flows to match each other and sealing the passages. It is also worth noting, that terminal devices of ventilation may not be the most suitable for office spaces.

- Heat recovery ventilation (HRV)

Currently the most energy consuming single component is heating radiator of basement ventilation system. Air volumes of the system seem to be massive for spaces with so little use. If it isn’t possible to setup HRV system to current ventilation system, the only energy saving measures are to check air volumes and add control switch for users.

Electrical system

- Lowering the temperature of supply air

Temperature of supply air was set quite high, to 21 – 24 °C, depending on the ventilation machine. Energy savings are possible by lowering temperature to 17 – 20 °C. This does require adjustment of supply airflow, since some of the users already suffer from draft.

Structures

Building's passages and duct require sealing, since cold air flowing through them affects negatively on energy efficiency and comfort. Possibility of adding insulation to attic floor should be investigated. Non-insulated heat pipes and ventilation ducts should be insulated.

Water consumption

Water consumption has been above typical office buildings' average consumption levels. Pressure of service water should be measured and if possible, reduce the pressure by decompression valve to restrict water flow. It is worth checking if any of water system's components require certain pressure level.

Consumption monitoring

The most important action to take is to start monitoring heating energy and electricity. Knowing, what amounts of energy is consumed is key to locating and defining energy saving potential. Consumption monitoring should be performed at least on a monthly level for each parameter. Great deviations of consumption is also a tool to spot faulty systems.