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Thermal performance of an earth to air heat exchanger designed for a low energy house

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Content:

➤ Energy consumption of buildings

➤ Description of Politehnica Building

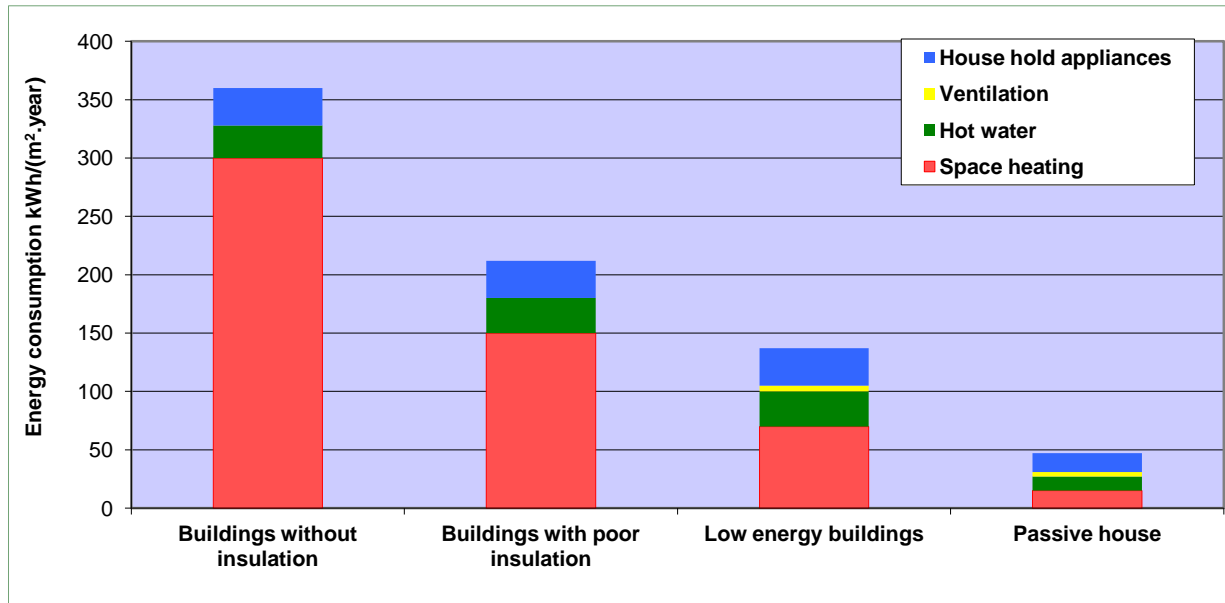
➤ Solution for heating/ventilating and cooling the space of Politehnica Building

➤ Study of the earth to air heat exchanger

➤ Conclusions



Energy consumption of buildings



EPBD - European Directive for Energy Performance of Building

- EPBD adopted in May 2010 strengthens the minimum energy performance of new buildings.
- EPBD sets as a target for 2020 the “Net Zero Energy Building”:



"POLITEHNICA HOUSE" Project

- **Two passive houses in one building**
- **Location: the campus of the University**
- **Surface of the building: 280 m²**



- **Southern side of the building**



- **Northern side of the building**



Solutions for heating/ventilating/cooling the space



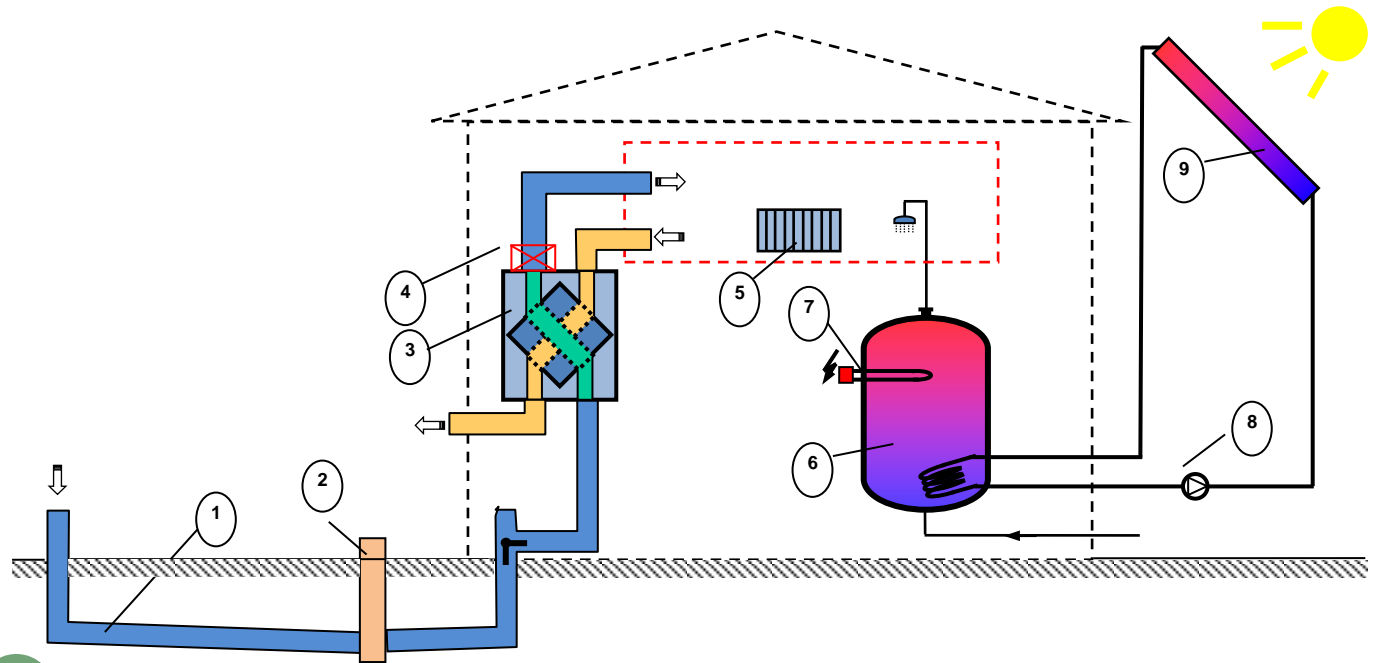
WEST HOUSE

- Geothermal heat pump
- Mechanical ventilation heat recovery unit
- Radiant panels

EST HOUSE

- Earth to air heat exchanger
- Mechanical ventilation heat recovery unit
- Electric resistance
- Radiant panels

HVAC system of "EST HOUSE"

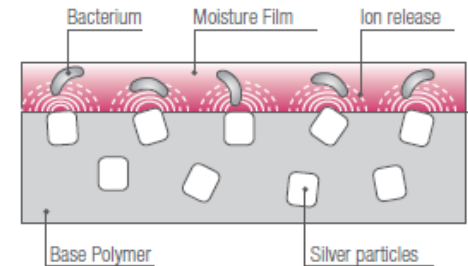


- 1) earth-to-air heat exchanger (EAHX); 2) condensation tower of the EAHX; 3) Mechanical ventilation heat recovery unit (MVHR) unit; 4) electric resistance for air heating; 5) radiant panel; 6) hot water tank; 7) electric resistance for water heating; 8) circulation pump; 9) solar panel.

Description of the EAHX

Properties:

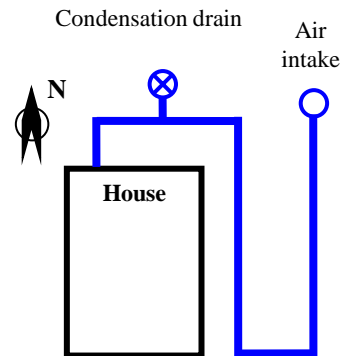
- Wall tightness: 7.8 mm
- Pipe diameter: 200 mm
- Thermal conductivity: 0.28W/m .K
- Length: 38 m



Pipe of the EAHX



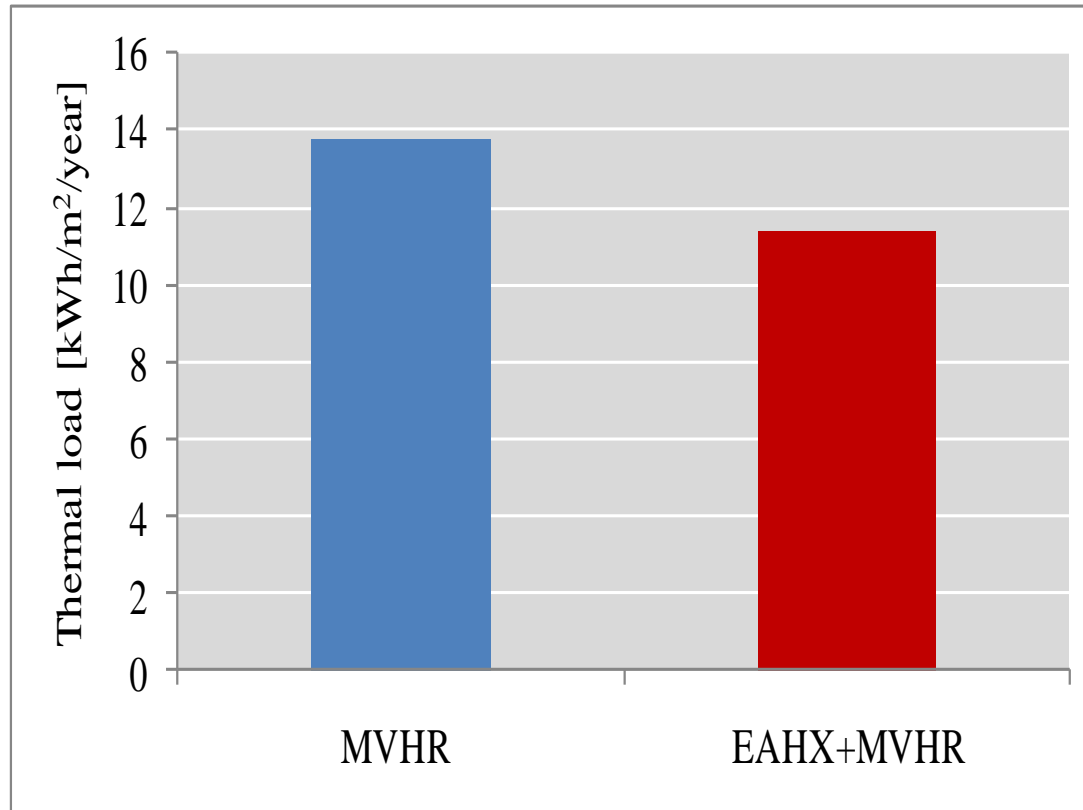
Configuration of the EAHX



Condensation tower of the EAHX



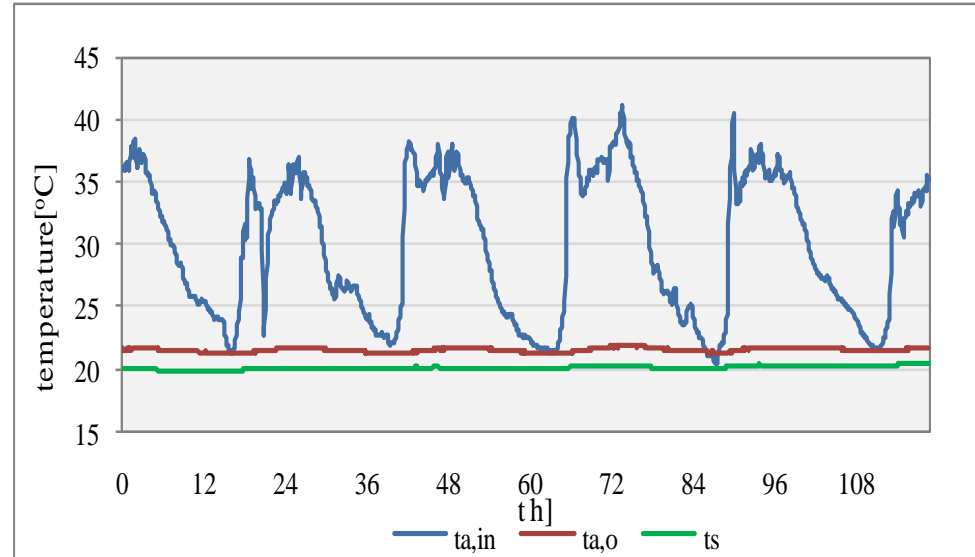
Influence of the EAHX on the thermal load of the house



Experimental study of the EAHX

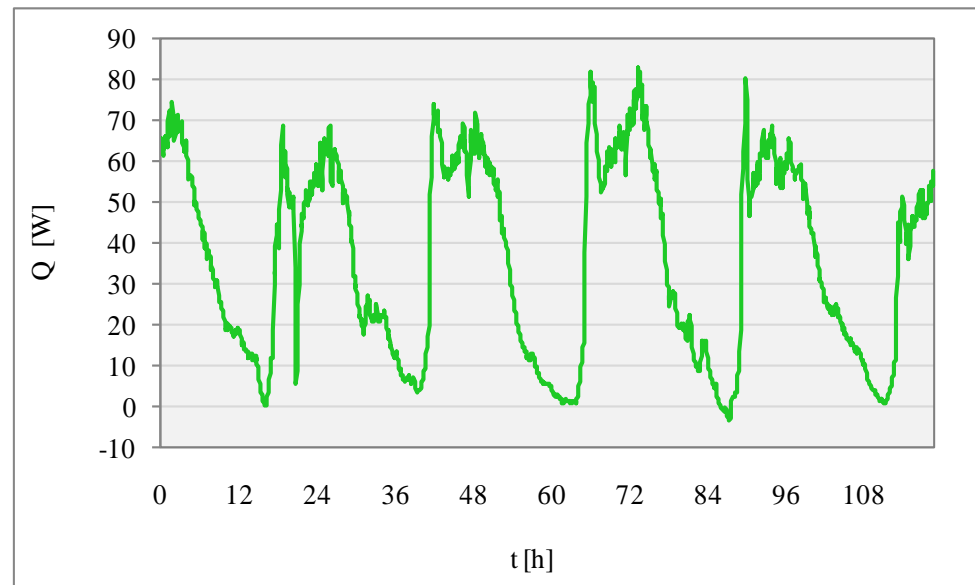
Temperatures in the Summer:

- $t_{a,in}$ – air temperature at the inlet of the EAHX;
- $t_{a,o}$ – air temperature at the outlet of the EAHX
- t_s – soil temperature



Heat transfer between air flow and soil:

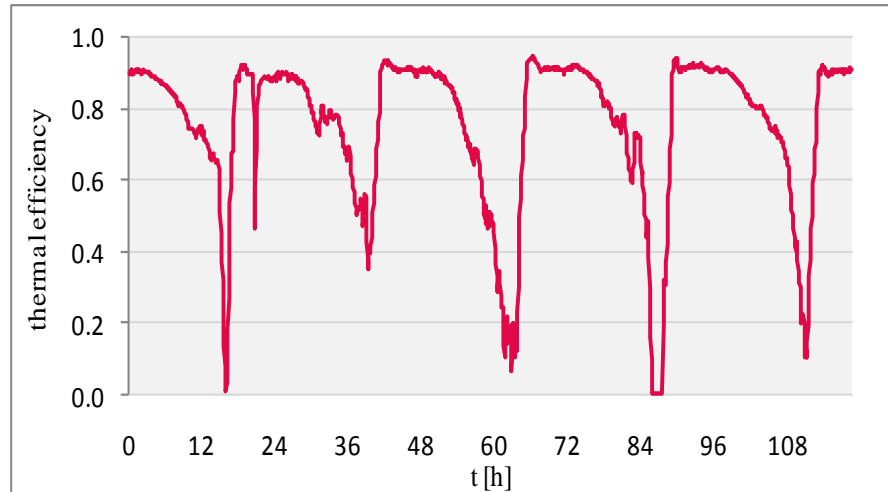
- Q – heat rate



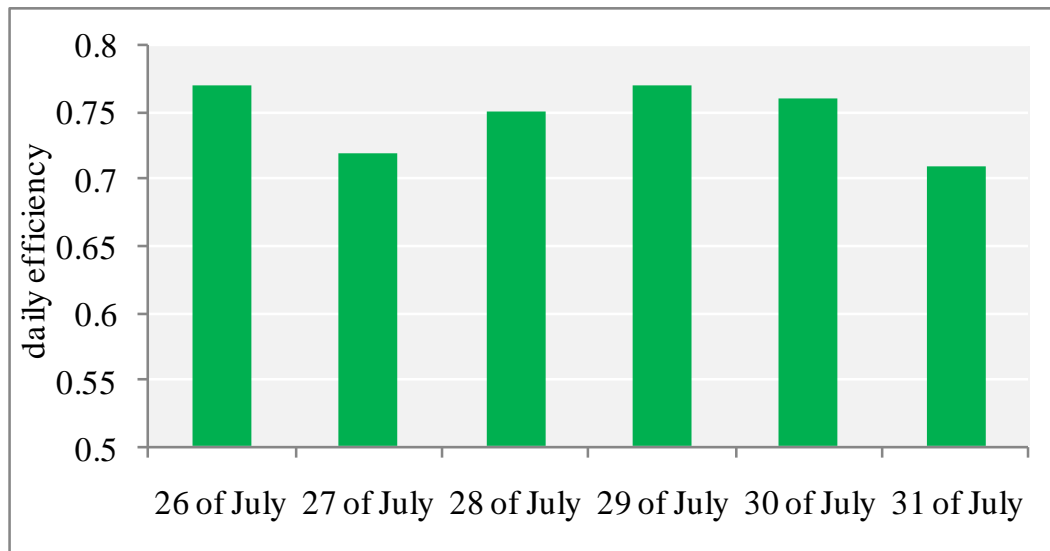
Thermal performance of the EAHX

➤ Thermal efficiency:

$$\varepsilon = \frac{t_{a,o} - t_{a,in}}{t_s - t_{a,in}}$$



➤ Daily thermal efficiency:



Conclusions:

- **The thermal efficiency is an important parameter, suitable to evaluate the thermal performance of the earth to air heat exchanger;**
- **The experimental study of the earth to air heat exchanger shows a good thermal efficiency of about 0.75 for a hot week in July;**
- **The earth-to-air heat exchanger has an important contribution in the primary energy consumption reduction; a low value of 11.5 kWh/m²/year is achieved only when the house is equipped with the MVHR and EAHX;**
- **The earth-to-air heat exchanger represents a clean solution able to provide, to preheat and to cool the fresh ventilation air;**



Thank you for your attention!

