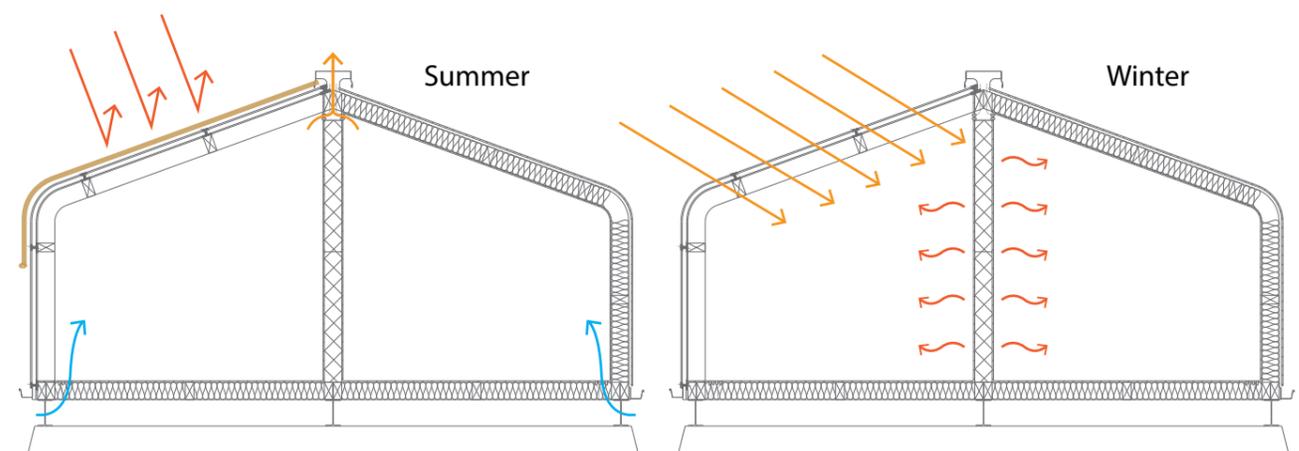
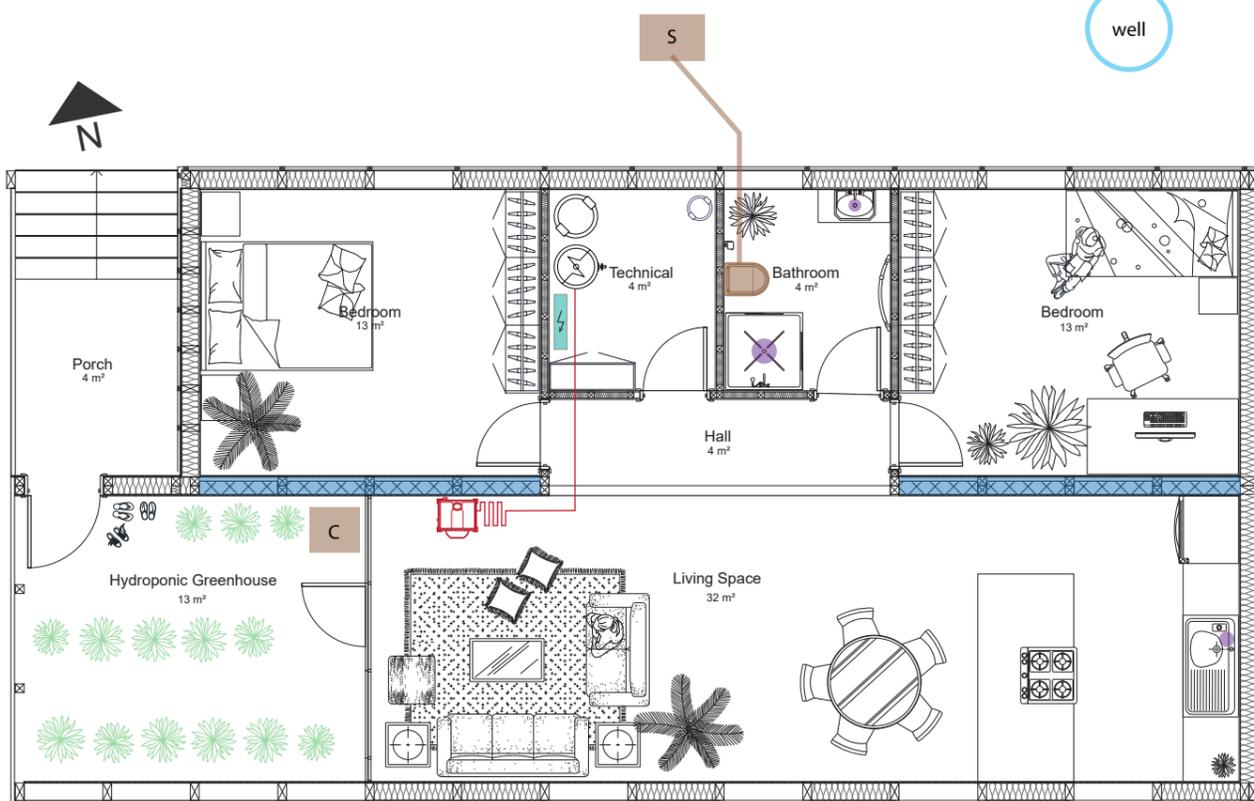
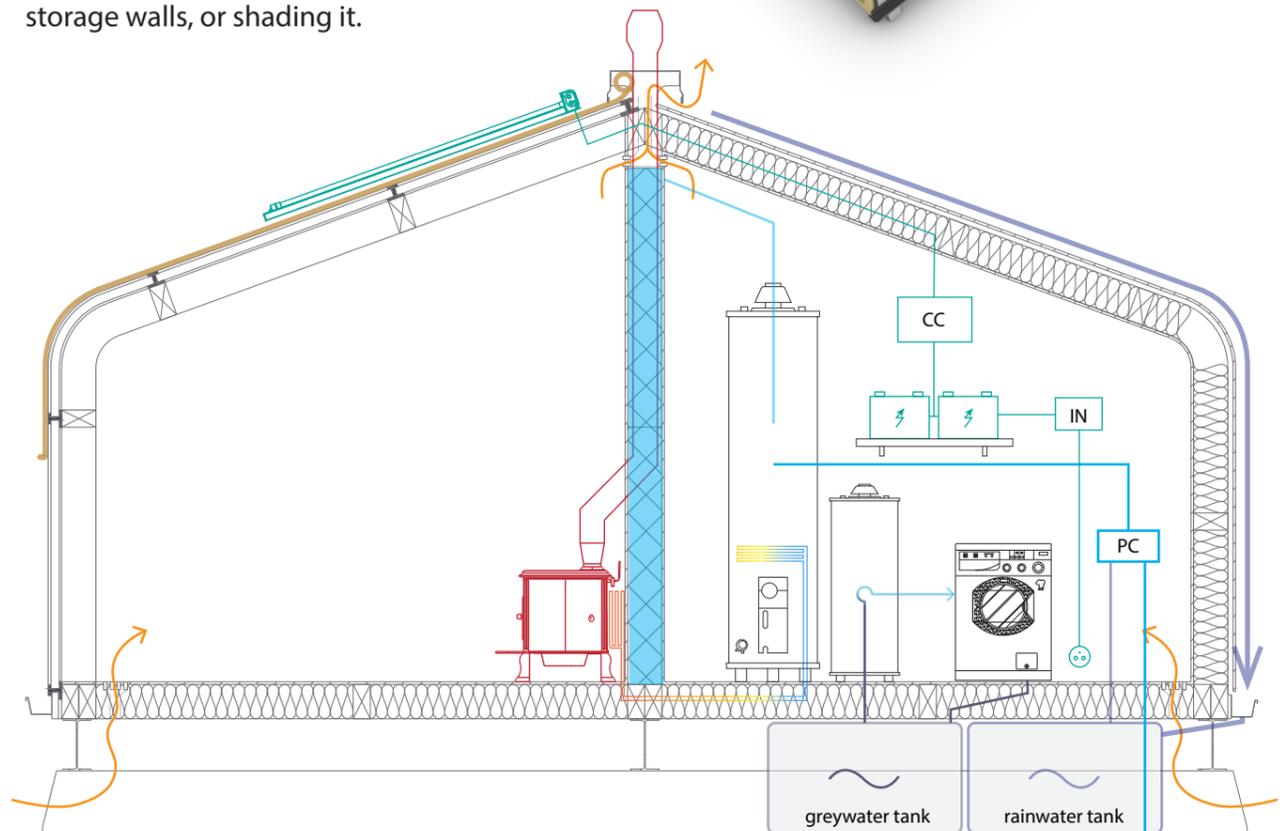
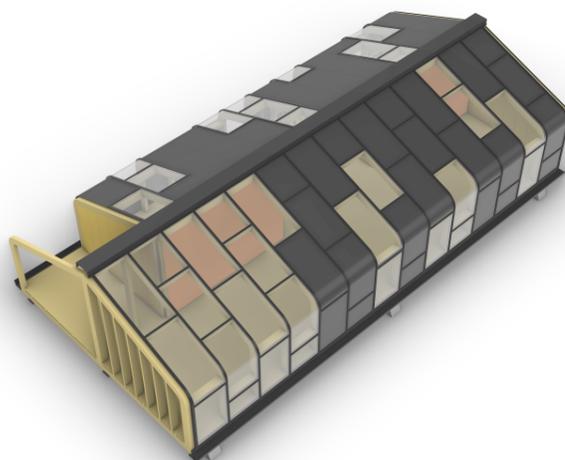


BIOCLIMATIC / PASSIVE / OFF-GRID / MODULAR



Seminárna práca, TZ2N, LS 2022/2023
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BPOM is a bioclimatic modular concept house that uses environmentally sustainable strategies to achieve a self-sufficient status. It combines passive, active, and bioclimatic principles. It features a large hydroponic greenhouse, serving as a symbiotic extension of the living spaces and providing the inhabitants with food. We attempted to use as many passive strategies as possible - opting for natural ventilation instead of mechanical one and controlling the temperature within the home by harvesting sunlight, storing its energy in heat storage walls, or shading it.



Wood burning stove

In the living room, there is a wood-burning stove. The stove burns biomass, a carbon-neutral fuel, to heat the home. It is directly heating the living spaces and the thermal mass in the adjacent wall. The residual heat is harvested with copper pipes that heat the domestic water via heat-exchanger. Furthermore, the wood-burning stove can be used for cooking, when the battery capacity is low.

Thermal mass wall

In the middle of the whole building, there's a 200 mm wall that serves as a thermal mass. It is composed of stainless steel containers filled with rain water, and can be used to irrigate the plants in the hydroponic system. Water has a high density and can absorb heat from direct sunlight and the woodstove. During the night, when the temperatures are lower, it radiates the heat into the living spaces.

Construction

The walls are built of timber, plywood, and soft batt insulation of 200 mm. The use of natural materials promotes a healthy living environment and reduces the carbon footprint of the construction. The insulation is high-performing mineral wool with a lambda value of 0.032 W/mK. The entire wall construction has a U-value of 0.12 W/mK.

Natural Ventilation

The whole structure is naturally ventilated. There are multiple vents along the edges of the floor, taking in the cool air from the bottom of the house into the living spaces. On the top of the thermal mass wall, vents are put in place along the ridge. During the summer, all vents are open to promote natural ventilation - warm air pulled upwards, creating updraft. In the summer all vents can be closed, preventing the heat from escaping the home.

Solar shading on the southern facade

A large portion of the southern facade is glazed. It helps heat up the spaces as well as the thermal storage wall. In the summer, a large awning fixed to the exterior of the curtain walls shades the windows. The surface of the fabric is reflective, but allows for a moderate amount of diffused light to penetrate the house. The shading can be adjusted, giving the dweller full control.

Water management

The house is supplied mainly by drinking water from the drilled well and rainwater. The rainwater collects in a 3m³ tank from which it can be pumped into the pump controller (PC) and subsequently used. Rainwater is also pumped into the thermal storage wall and used for plant irrigation or cleaning. There is also a greywater harvesting system in use. The greywater is harvested in a container and pumped into a membrane filter, where it purifies into white water. White water is then used in washing machines or for flushing.

Septic Tank / Composting toilet

We opted for a composting toilet in the bathroom. The system separates solid from liquid waste. Solid waste is composted and then can be used as fertilizer for hydroponics. The liquid waste is disposed of in a septic tank further from the house.

Hydroponic Greenhouse

The house is never fully off-grid unless it can grow its food. The plants within the greenhouse provide a source of food, create oxygen and help cool the air. The greenhouse can be cross-ventilated during the summer by opening the entrance doors or help heat up the living spaces by opening towards them.

Photovoltaics and Solar collectors

On the roof, there is an array of photovoltaic panels. The total area of the panels is 28 m². Panels are fixed under a 15° roof slope - not ideal, especially during the winter, but sufficient. We also install solar water collectors of 6 m². The heated water leads into a heat exchanger and helps heat the domestic water.

Water saving taps with heat recovery

The building is equipped with water-saving taps, both in the bathroom and the kitchen. Additionally, heat recovery systems may be installed below these appliances. This can help save heat energy, which would otherwise be lost.

Energy efficient appliances

The more sophisticated the technologies, the more appliances the house utilizes. Therefore, all appliances in the house must be energy efficient. We use energy marks of A++ to A to save as much energy as possible.