

Ecological energy-efficient insulation materials

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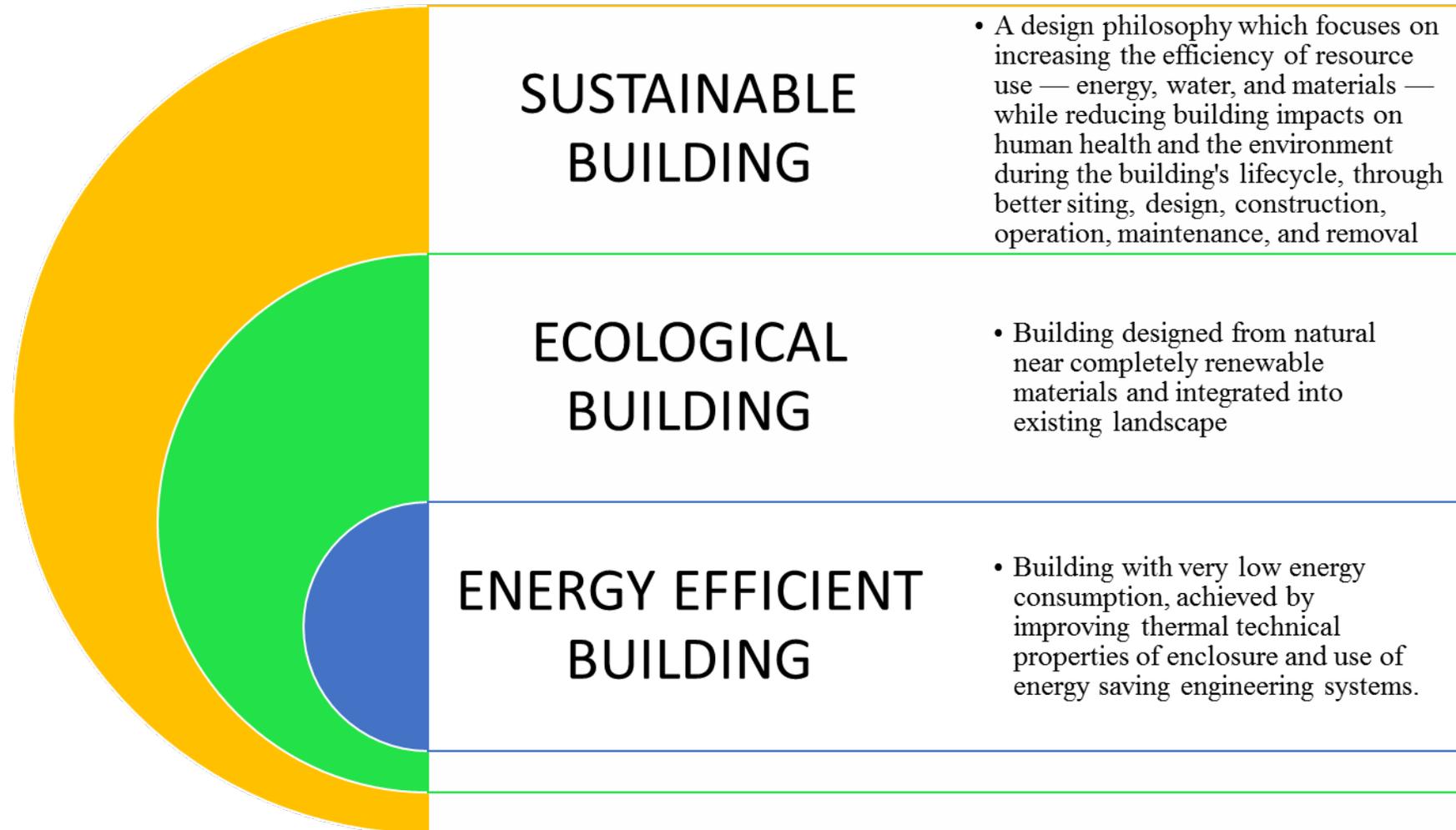


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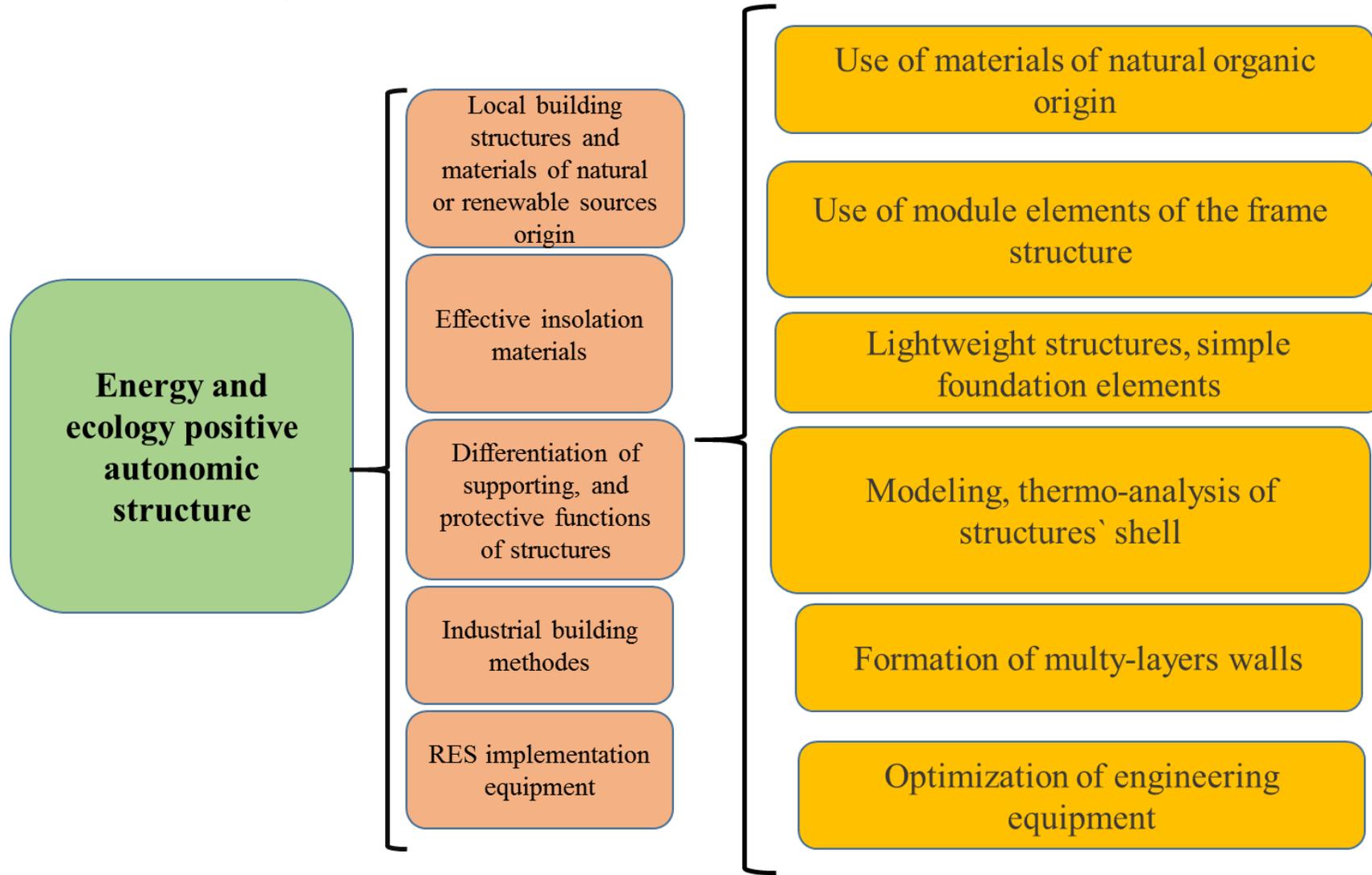
SLOVAK UNIVERSITY OF
TECHNOLOGY IN BRATISLAVA



Evolution of a notion "Sustainable building"



Principles of structures formation



SUSTAINABLE DEVELOPMENT AND CIRCULAR ECONOMY IN CONSTRUCTIONS' MATERIALS



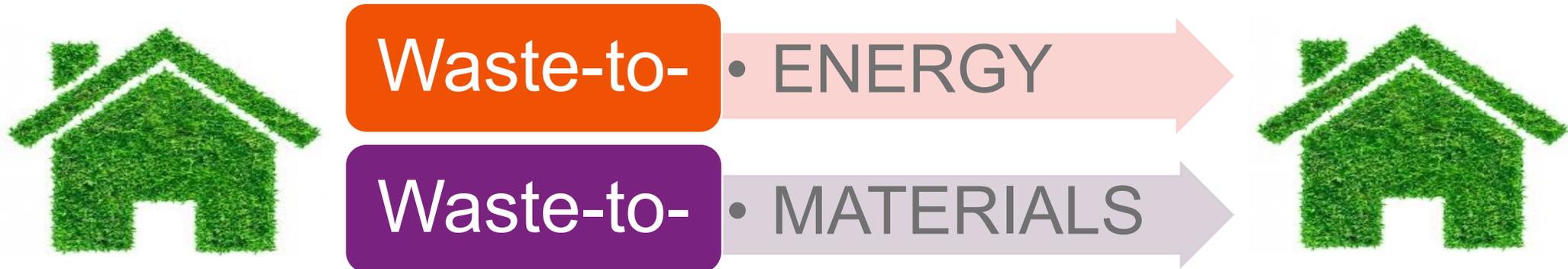
CIRCULAR ECONOMY
saving resources, creating jobs

<https://www.activehouse.info/construction-sector-is-key-to-europes-energy-and-resource-efficiency/>

The circular economy package, adopted by the EC on 2 December 2015, has created an important momentum to support the transition towards a more circular economy in the EU. This package included legislative proposals on waste, with long-term targets to reduce landfilling and increase recycling and reuse.

WHAT DO YOU MEAN WITH CIRCULAR BUILDING SECTOR?

That material will not end up as waste. Through design and circular value chains, materials in a building sustain their value. Instead of being to-be waste, buildings will function as banks of valuable materials – slowing down the usage of resources to a rate that meets the capacity of the planet.



NZEB insulation materials requirements taking into account environmental aspects

- **Coefficient of thermal conductivity of the material** - this characteristic is equal to the amount of heat passing through a homogeneous sample of material of unit length and unit area per unit time at a unit temperature difference (1 K). In other words, how energy efficient the building envelope will be largely depends on this indicator. The recommended minimum value of the thermal conductivity of the insulation material is $0.07 \text{ W} / (\text{m} \cdot \text{K})$;
- **Vapor permeability** - the ability of the material to pass or retain steam as a result of the difference in partial pressure of water vapor at the same atmospheric pressure on both sides of the material. Vapor permeability is characterized by the value of the vapor permeability coefficient or the value of vapor permeability resistance when exposed to water vapor. The vapor permeability coefficient is measured in $\text{mg} / (\text{m} \cdot \text{h} \cdot \text{Pa})$. This is a very common problem when using highly energy-efficient materials that "do not breathe", so it is necessary to provide for the installation of a vapor barrier;
- **Material composition** - an important characteristic in the context of environmental performance and optimization of the life cycle of the building. It is usually acceptable when declaring the environmental friendliness of a building to maximize the use of natural materials, with a minimum component composition in all types of structures and interior elements of the building.

Modern widely used insulation recycled materials

BUILDING MATERIALS MADE FROM WASTE

AGRICULTURE WASTE

Straw, hemp, reed, flax etc. as pure and aggregate



DOMESTIC WASTE

Newspaper Wood



<http://www.newspaperwood.com/about/>

Wine cork panels



<http://www.jelinek.com/closures-stoppers/recycled-wine-corks/>

Nappy roofing



http://www.buildersmerchantsnews.co.uk/news/archivestory.php/aid/551/From_nappy_to_roof_tile.html

INDUSTRIALIZED EXAMPLES

HOME-MADE INDIVIDUAL APPROACH

The background research

- A comprehensive study of the thermal properties of the straw wall structure was conducted in a large climate chamber TiR32 in the Laboratory of Building Physics, Faculty of Civil Engineering (Slovak University of Technology in Bratislava).
- The thermal conductivity coefficient at different temperatures for the studied structure of the walls ranges from 0.095 to 0.068 W / (m . K) in accordance with external temperature conditions.

The background research

- The studied efficiency of infra-red film for heating was analyzed according to the maintained temperature in the room ($\geq +20$ °C) and provided the required temperature barrier. On average, to maintain the required internal temperature for 10 hours at an external temperature of +5 °C, the heating layer must operate at maximum mode (140 W) for 1 hour; to maintain the required internal temperature for 4-6 hours at an external temperature of 15 °C, the heating layer must operate at maximum mode (140 W) for 1 hour.

The background research

- According to the results, the most favorable operating conditions for environmental insulation based on flax straw is a humidity regime corresponding to 50% relative humidity and in the process of desorption of the material, at which the thermal conductivity is 0.07-0.08 W / (m . K).
- In sorption conditions, in relation to 50%, the situation leads to a significant increase in the thermal conductivity of the investigated material, almost to 100%, i.e. 0.14 - 0.16 W / (m . K), which significantly impairs the thermal properties of the overall developed eco-insulation.

Thank you for your attention!

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