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EVALUATING BUILDING ENVELOPES FOR ENHANCED ENERGY EFFICIENCY: A COMPREHENSIVE ASSESSMENT APPROACH

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Abstract

Evaluating and understanding the crucial control functions of a high-performance building enclosure, such as water management, air control, heat control, vapour control, and critter control, is a necessary step in analysing the theory and practice of the overall building enclosure structure. This analysis is crucial for new construction projects to guarantee building longevity, occupant comfort, and energy efficiency. This research determines the theory and practice of building enclosure structures, which is critical for designing high-performance, long-lasting, and energy-efficient structures that promote human comfort and well-being.

Keywords: Building Envelope Testing (BET), energy performance of enclosure structures, enhanced energy.

Introduction

Building envelopes are essential for energy efficiency as they provide insulation and reduce heat transfer between the interior and exterior. Building Envelope testing (BET) is a method of assessing a building envelope that requires a thorough inspection of the structure's exterior to determine its insulation and air tightness.

A complete assessment approach for evaluating building envelopes entails a multifaceted examination of the structure's design, construction, and operational aspects. This includes assessing the building's thermal performance, air tightness, insulation, and moisture management. The assessment approach should also consider the impact of architectural features like floor area, vertical envelope area, vertical envelope area to floor area ratio, window-to-wall ratio, age, and building type.

Building Envelope Testing (BET) is one method for evaluating building envelopes. It entails thoroughly examining a structure's outside to determine its insulation and air tightness. BET provides vital data for architects, engineers, and builders to make informed decisions during design and construction, resulting in more energy-efficient buildings. In addition to BET, other approaches for evaluating building envelopes include using building information modelling for energy efficiency studies, thermal performance assessments, and energy benchmarking.

The main part of the research

Building Enclosure Structure and its Functions

The building enclosure structure is an essential aspect of building design because it separates the interior from the exterior and protects occupants from the elements. The analysis of the building enclosure structure entails understanding the physical and functional requirements of the enclosure, including water control, air control, thermal control, vapour control, and critter control [1]

Materials of Building Enclosure Structures

The exact design and use of the building will determine the materials used for its enclosing structures. A building's structure and enclosure are composed of many elements, such as concrete, masonry, steel, wood, glass, and insulation.

Building Enclosure Measures in Net-Zero Building Design

Net-zero building enclosure measures are crucial for achieving a sustainable and energy-efficient building design. These measures focus on optimising the building envelope to minimise energy consumption while maintaining occupant comfort, as shown in Figure 1.

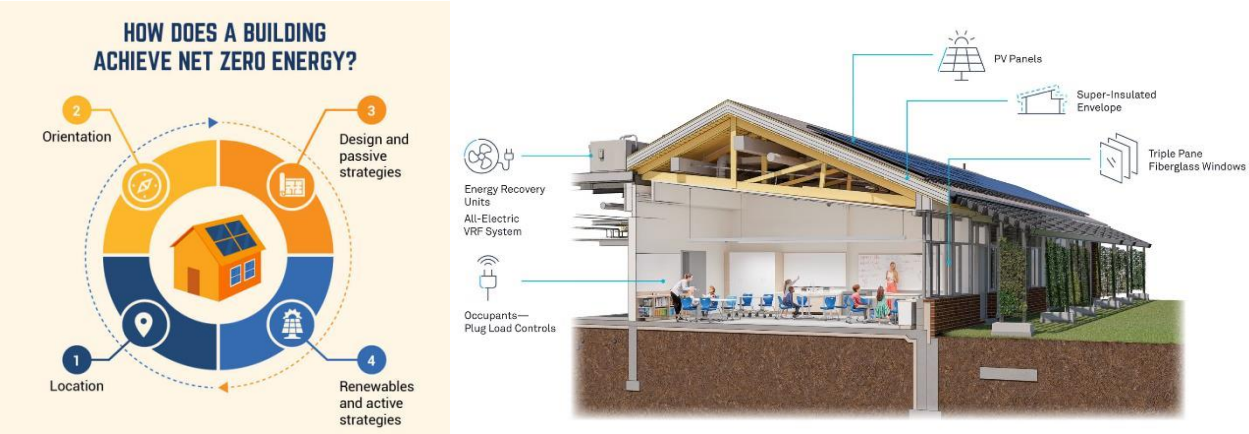

Figure 1. Example of Achieve Net-Zero Energy [3]

Implementation Strategies for the nZEB

Figure 2 shows the nZEB strategies focusing on achieving high energy performance while mini-mising energy consumption and maximising renewable energy sources. These strategies aim to transition buildings towards a net-zero energy balance, where the energy consumed is offset by on-site or nearby renewable energy generation. Net-zero building enclosure measures are critical for achieving a sustainable and energy-efficient building design.

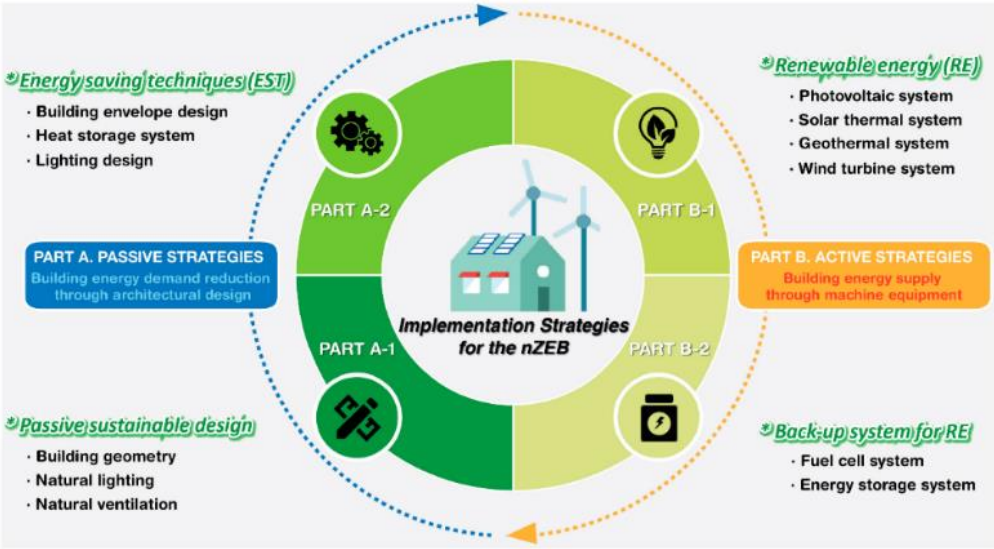

Figure 2. Example of a Strategy for nZEB [4]

Highly Insulated Walls

The research on highly insulated walls focuses on superior thermal insulation [2] in building design to enhance energy efficiency and occupant comfort.

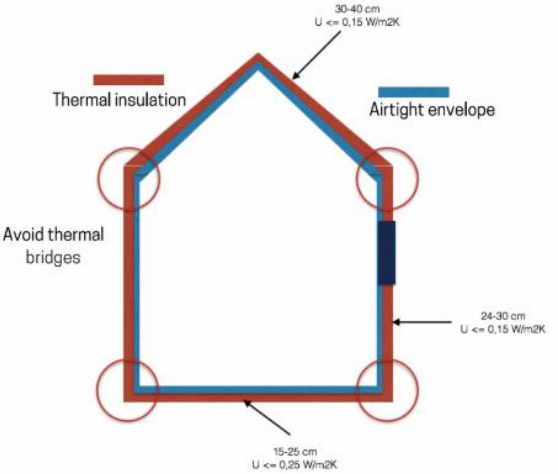

Figure 3. Example of Passive House Thermal Insulation [5]

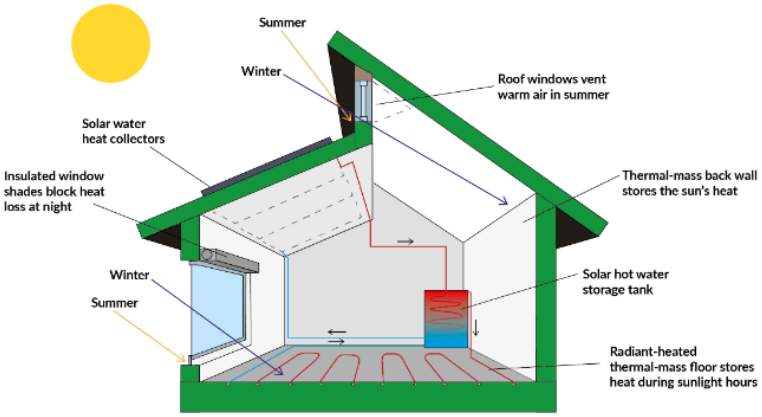

Figure 4. Example of Passive House [6]

Innovative Ventilation Systems for Building Circulation

Innovative ventilation systems for building circulation include air well design, building façade design, and ventilation openings, as shown in Figure 5

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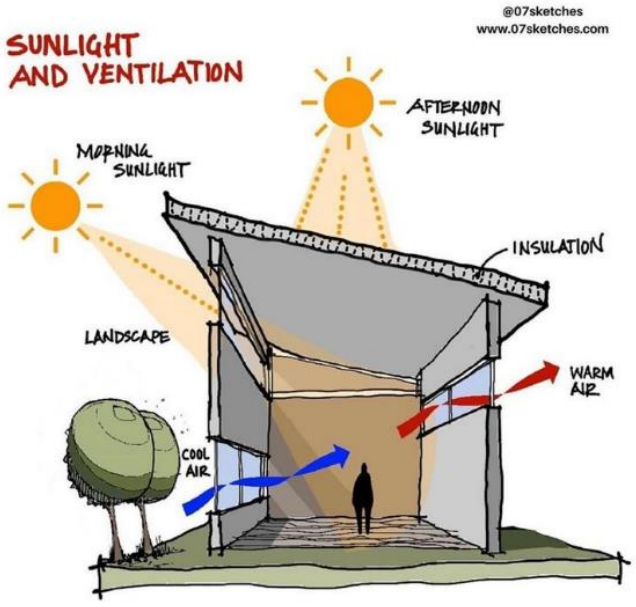

Figure 5. Innovative Ventilation System [7]

Conclusion

Building enclosure structures is a multifaceted endeavour that encompasses understanding the fundamental functions, physical characteristics, and adaptability techniques necessary to create high-performance building enclosure structures. By using these advanced materials, design strategies, and evaluation methods, building professionals can contribute to developing more energy-efficient, resilient, and sustainable built

environments. Also, a comprehensive assessment approach to evaluating building envelopes is crucial in achieving enhanced energy efficiency and sustainability in the built environment. By leveraging various evaluation methods and tools, building professionals can make informed decisions, develop targeted improvement strategies, and contribute to creating high-performance, energy-efficient buildings that meet the evolving needs of occupants and the environment.

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