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Sustainable Building Design Principles & Practices - An Overview

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ABSTRACT

There deserves more research and development done on individual components as well as combinations of components in systems in order to create a more sustainable construction industry. This problem cannot be solved in a single way; instead, a variety of technological and socioeconomic approaches must be used. A Swedish pilot project that makes use of shared technology is described below. Users do have issues with the technology, though. Easy-to-use technology is crucial to creating buildings that are energy-efficient. Both the performance of the structure and the energy usage of its occupants are influenced by policies. The product that the consumer is using was created in accordance with policies, such as building codes, energy goals set by the builder, and the design team's expertise in energy design. The building industry will benefit from an energy strategy that places a strong emphasis on low energy usage.

KEYWORDS: *Passive Design, Green Building, Smart Technologies, Adaptability, Energy Efficiency.*

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INTRODUCTION

Sustainable building design revolves around creating structures that reduce negative impacts on the environment while ensuring efficient resource use, promoting occupant health and well-being, and being economically viable. Sustainable Built Environments: Principles and Practice offers detailed environmentally sound design solutions to a wide range of building engineering challenges. The text uses case examples and project data provided by engineers and designers at Arup Associates. It covers a broad range of relevant issues, with focused commentaries and explanations presented in an accessible format for use by students, busy practitioners and informed clients.

Fig.1 Sustainable Design

Sustainable design has become increasingly popular in recent years, so much so that it is often utilized without comprehensive understanding. Sustainable development is undoubtedly a widely recognized goal in the 21st century. However, defining the term can be a formidable task due to the myriad of preconceived notions and interpretations associated with it. These principles and practices collectively aim to reduce environmental impact, enhance efficiency, and create healthier, more adaptable buildings for a sustainable future. Sustainable building design involves a comprehensive and integrated approach, considering various factors from design and construction to operation and eventual decommissioning or reuse. Its goal is to create buildings that contribute positively to environmental conservation, human health, and the well-being of communities.

PASSIVE DESIGN

Passive design refers to a set of architectural and design strategies used in building construction to optimize natural elements such as sunlight, airflow, and heat to create comfortable indoor environments without relying heavily on mechanical or artificial systems. This design approach aims to maximize the building's performance, energy efficiency, and occupant comfort by utilizing natural resources and elements effectively. Here are key aspects of passive design:

Orientation and Layout:

Solar Orientation: Positioning the building and its openings (windows, doors) to maximize or minimize exposure to the sun depending on the climate. This helps in capturing solar heat during winters while shading against excessive heat in summers.

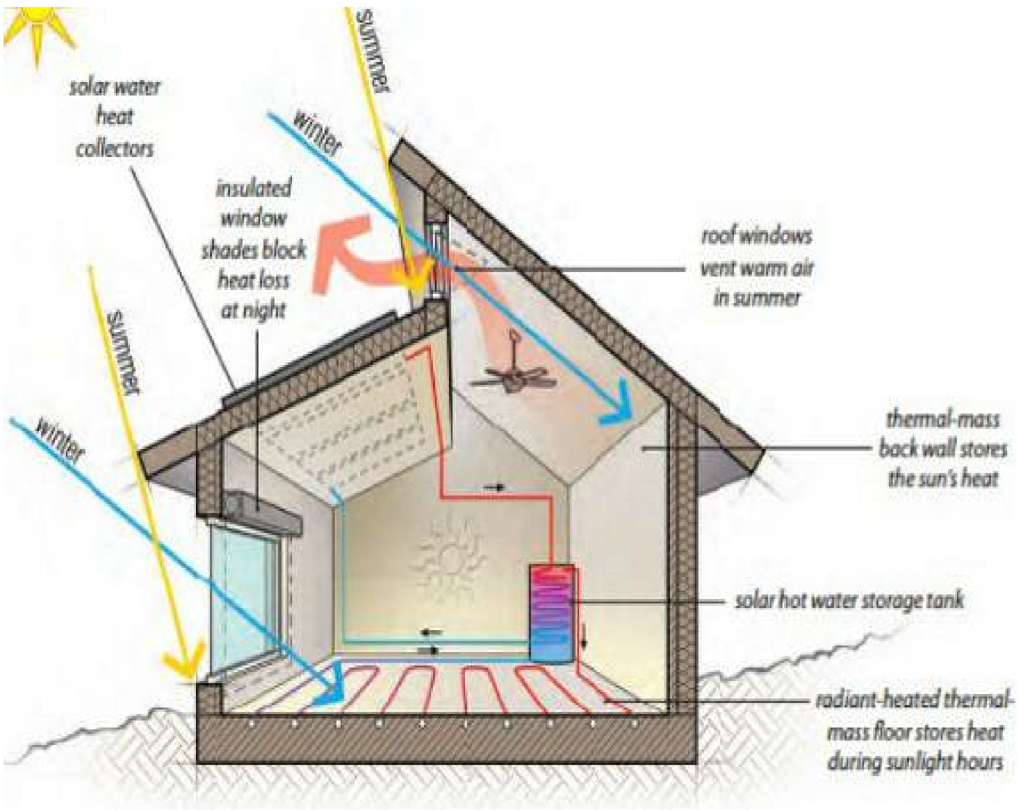

Fig.2 Passive Design

Site Specificity: Consideration of local climate, prevailing winds, and geographical features to plan the building's layout for optimal natural light and ventilation.

Natural Ventilation:

Cross-Ventilation: Strategic placement of windows and openings to facilitate the flow of fresh air through the building, allowing for cooling breezes.

Stack Ventilation: Utilizing the principle of hot air rising and cool air sinking to create natural airflow, often implemented with high and low openings to promote air circulation.

Benefits of Passive Design:

Energy Efficiency: Reducing reliance on mechanical systems for heating and cooling, leading to lower energy consumption and operational costs.

Improved Comfort: Creating more comfortable indoor environments with stable temperatures and better air quality.

Environmental Sustainability: Lowering carbon footprint and environmental impact by using natural resources more efficiently.

Passive design principles can be applied across various building types and climates, offering a sustainable and cost-effective approach to designing buildings that are more responsive to their surroundings and occupants' needs.

GREEN BUILDING

Green building refers to the practice of creating structures that are environmentally responsible, resource-efficient, and sustainable throughout their lifecycle. It involves using design, construction, operation, and maintenance techniques that reduce the building's environmental impact while enhancing the health and well-being of occupants. Here are key aspects of green building:

Sustainable Site Selection and Planning:

Site Selection: Choosing locations that minimize environmental impact, optimize land use, and have access to public transportation or promote alternative commuting options.

Land Use: Preserving natural features, minimizing disruption to ecosystems, and promoting biodiversity on-site.

Material Selection and Resource Efficiency:

Sustainable Materials: Using eco-friendly, recycled, or locally sourced materials with low embodied energy and reduced environmental impact.

Waste Reduction: Minimizing construction waste through responsible sourcing, recycling, and reusing materials.

Fig.3 Green Building

SMART TECHNOLOGIES

Smart technologies in the context of buildings refer to the integration of various systems and devices that use data, connectivity, and automation to enhance efficiency, comfort, safety, and sustainability within a built environment. These technologies leverage interconnected devices and data analytics to optimize building operations and improve user experiences. Here are key components and applications of smart technologies in buildings:

Energy Management:

Smart Meters: Devices that monitor and track energy consumption in real-time, enabling better control and management of energy use.

Renewable Energy Integration: Systems that manage and optimize the use of renewable energy sources such as solar panels or wind turbines.

Security and Safety:

Smart Security Systems: Integration of surveillance cameras, access controls, and alarm systems that can be monitored and controlled remotely.

Fire and Safety Systems: Automated fire detection, alarm, and suppression systems for improved safety.

Benefits of Adaptability:

Cost Efficiency: Reducing the need for frequent renovations or rebuilds by accommodating changes through adaptability.

Sustainability: Extending the lifespan of buildings and reducing waste associated with frequent construction or demolition.

User Satisfaction: Providing spaces that can be tailored to evolving user preferences and needs.

Fig.4 Smart System

ENERGY EFFICIENCY

Energy efficiency in building design focuses on reducing energy consumption while maintaining or improving the performance and comfort of the built environment. It involves employing strategies and technologies to optimize energy use, minimize waste, and reduce the environmental impact of buildings. Here are key aspects and strategies related to energy efficiency in buildings:

Building Envelope:

Insulation: Properly insulating walls, roofs, and floors to minimize heat transfer and maintain stable indoor temperatures.

High-Performance Windows: Installing energy-efficient windows with double or triple glazing, low-emissivity coatings, and proper framing to reduce heat gain or loss.

Air Sealing: Sealing air leaks and using airtight construction methods to prevent drafts and energy losses.

Efficient HVAC Systems:

High-Efficiency Equipment: Installing energy-efficient heating, ventilation, and air conditioning (HVAC) systems with high Seasonal Energy Efficiency Ratio (SEER) ratings.

Programmable Thermostats: Using smart or programmable thermostats to regulate temperature settings and optimize energy use based on occupancy schedules.

Zoning and Controls: Implementing zoning systems and controls to distribute heating and cooling where and when needed.

Lighting:

LED Technology: Utilizing LED lighting fixtures that are highly efficient and have a longer lifespan compared to traditional incandescent or fluorescent bulbs.

Occupancy Sensors and Daylight Harvesting: Incorporating sensors to control lighting based on occupancy and natural light availability, reducing unnecessary energy usage.

Renewable Energy Integration:

Solar Panels: Installing photovoltaic (PV) systems to generate on-site renewable electricity and reduce reliance on grid power.

Wind Energy: Where viable, incorporating small-scale wind turbines to harness wind power for electricity generation.

Fig.5 Energy Efficiency

CONCLUSION-

Sustainable building design aims to create structures that not only minimize negative impacts on the environment but also promote healthier, more comfortable, and economically viable spaces for occupants. By integrating these principles and practices, sustainable buildings contribute positively to environmental conservation and human well-being. It is obvious that more openness between international and national rating systems is necessary for the international assessment market to develop. As owners seek to show their dedication to the environment and the highest performance standards, transparency should boost competition and foster an atmosphere that tends towards an improvement of standards. If common criteria are agreed upon for important topics like greenhouse gas emissions, standards will function more efficiently. Having common criteria is necessary to go on to the next development phase. A market for licencing, cross-certification and multiple labelling may eventually develop. Owners would be able to adopt regional, global, and local market norms under such a framework.

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