

## **Building technology in achieving thermal comfort within buildings**

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### **Abstract:**

Architectural design aims to create architectural buildings and spaces that achieve the highest extent of the late occupants of these spaces through the use of building materials that interact with human senses And so the role of building technology in architectural work was to create a system for using sophisticated construction material, So that the inner vacuum shape is designed dynamically, it can handle the natural human requirements, In terms of the liquidity of air mobility with its natural laws, and control of the flow of solar energy with its daily rhythms, Adding to the functional ease of use of internal vacuum elements, resulting in the same material a smart outer envelope that can interact with external bioenergy data, which profoundly affects the comfort of man, and since the building materials of the architectural vacuum envelope are so important as to affect man, ancient times have been called the same material. (Stone Age - Bronze Age...), so architectural when designing architectural spaces must, He knows the art of using old building materials and how to handle them, the role of old technology in controlling those materials and working on their development.

The impact of the evolution of the building material on humans and its negative and positive impact on the biology of the human body and the amount of success that old technology has achieved in achieving human thermal rest factors, Bearing in mind that the buildings were formed by the natural material used in the construction in all its characteristics and to the maximum extent possible in relation to its handling of the external environment, Through the use of the material successful architectural formations have been made throughout history as a result of controlling the development of materials with predetermined characteristics, According to the functions required of the material, the effect of those characteristics has shifted to the formed environment within the building, As a result, intelligent

covers of new architectural spaces have contributed to the formation of an architectural vacuum and the achievement of human comfort.

**Keywords:** Building technology- thermal- Architectural design- renewable energy

**Introduction:**

Construction technology plays an important role in achieving thermal comfort within buildings, contributing to improved energy efficiency and reduced fuel consumption for heating and cooling. There are many techniques and practices that can be adopted in the design and construction of buildings for thermal comfort, including: Improved thermal insulation: Includes the use of high-efficiency thermal insulation materials in walls, ceilings and flooring to reduce heat loss in winter and heat penetration in summer. Insulating glass: Use double or double thermal insulating glass with insulating layer to reduce heat loss and provide acoustic insulation at the same time.

Natural ventilation: The design of an effective ventilation system allows fresh air flow and disposal of hot air without the need to use air conditioning equipment. The use of smart technologies: technologies such as smart temperature and lighting control systems, smart sensors to modify ventilation and cooling according to current conditions. Renewable energy: The use of renewable energy such as solar power to generate electricity or direct heating can contribute to meeting heating and cooling needs in environmentally friendly ways. Environmental design: innovative and sustainable designs ensure the use of local sources and environmental materials and provide innovative design solutions such as the use of

This research touches on the data between the architectural vacuum and the technology and the thermal comfort of the environment. This relationship is determined by the concept of the architectural vacuum and its evolution and the factors affecting it. The shape of the vacuum is influenced by several effects of alignment and orientation in terms of. Construction and construction systems and environmental methods and factors of natural factors and modern factors and systems within it. The science of city planning has evolved with increased attention to the environment and the need to preserve it which has become aimed at reducing all negative environmental impacts resulting from population, industrial and service activities in Uncle Rennie, Because the environment generally carries a certain

amount of pollution that it is usually able to automatically dispose of but then it becomes difficult to overcome this pollution and turns into a risk that affects everyone who lives within it. This development in the field of city planning was necessitated by the fact that the traditional theories of planning Uncle Rani proved her inability to address planning problems and its dimension of realism as she relied on defining the outline of land use based on specific visions or laws away from the environmental aspect and preserving it. All of which led the city to a state of disconnectedness with the environment, so this science had to be developed to reflect the notion of sustainable environmental urbanization that human beings are at the center of the relationship between the environment - the economy - the meeting, because the impact of human activity on the environment has clear economic and social dimensions that are reflected at the beginning and the end.

There are many construction technology methods that can be used to achieve thermal comfort within buildings. Some of these methods include:

**Thermal insulation:** The use of high efficiency thermal insulation materials in walls, ceilings and flooring to reduce heat loss in winter and heat penetration in summer.

**Insulating glass:** Use double thermal insulating glass or multi-layered glass with insulating layer to reduce heat loss and provide acoustic insulation at the same time.

**Mechanical ventilation:** Installing advanced mechanical ventilation systems that use heat exchangers to recover heat from the air used to heat the next new air. **Solar panels:** The use of solar panels to generate electricity and heat water can reduce the use of conventional energy and reduce heating and cooling costs. **Solar windows and umbrellas:** use thermal insulating windows and solar umbrellas to reduce heat penetration, control solar radiation in summer and keep heat in winter.

**Smart control systems:** The use of smart temperature and lighting control systems can help improve energy efficiency and provide appropriate thermal comfort in living and office spaces.

**Ceiling thermal insulation:** The use of effective thermal insulators in the ceiling can protect the building from excess solar heat and improve heat distribution indoors.

**Refrigerated and heated ground systems:** The use of refrigerated flooring in summer and heated flooring in winter can enhance thermal comfort and reduce the use of

conventional heating and cooling systems. These are just some examples of construction technology methods that can be used to achieve thermal comfort within buildings. These methods should be coordinated and implemented in an integrated manner according to the requirements of each project and the surrounding climate conditions. True, thermal insulation is an important element in achieving thermal comfort within buildings. The use of highly efficient insulating materials in walls, ceilings and flooring reduces heat loss in winter and prevents heat penetration in summer.

**Some types of thermal insulation materials used include:**

Cell thermal insulation: such as enlarged polystyrene (EPS), polyurethane (PU) and expanded polyethylene (XPS). These materials are characterized by their ability to hold antenna in small cells and provide effective thermal insulation.

Fiberglass: used in the form of plates or fibers to provide good thermal insulation and mechanical stability. Fiberglass reduces heat transmission through walls and ceilings.

Organic thermal insulation: such as rock wool, cannabis and straw. This material is characterized by its ability to absorb and insulate heat and provide a comfortable environment within the building. Foam thermal insulation: such as expanded polystyrene and polyurethane. This material is used as foam to provide effective thermal insulation and reduce heat loss by conducting and transporting.

The installation and application of these insulating materials must be properly carried out in accordance with established standards and directives to ensure maximum effectiveness of thermal insulation and achieve desired thermal comfort within the building. Absolutely, natural ventilation is a key element in achieving thermal comfort inside buildings. By designing an effective natural ventilation system, fresh air can flow through the building, allowing for the exchange of stale indoor air and the disposal of hot air.

Here are some factors to consider when designing a natural ventilation system:

Building orientation: Orienting the building to maximize the intake of fresh air and facilitate the flow of air currents is important. This can be achieved by positioning windows, doors, and openings to take advantage of prevailing winds.

**Window design:** Using windows that can be easily opened and closed, such as casement or awning windows, allows for control over the amount of fresh air entering the building. Positioning windows at different heights and on opposite sides of the building can promote cross-ventilation. **Ventilation openings:** Incorporating vents, louvers, or operable skylights in strategic locations can facilitate the intake and exhaust of air. These openings should be positioned to take advantage of natural air movements and be adjustable to regulate airflow.

**Stack effect:** Utilizing the principle of stack effect, which relies on the difference in temperature and density between indoor and outdoor air, can promote natural airflow. Warm air rises and escapes through high-level openings, drawing in cooler air from lower openings. **Building envelope:** Ensuring the building envelope is well-insulated and airtight is important to prevent unwanted heat transfer and drafts.

Proper insulation helps maintain a comfortable indoor temperature, reducing the need for mechanical cooling or heating.

**Shading and external elements:** Incorporating shading devices, such as awnings, overhangs, or vegetation, can help reduce solar heat gain and minimize the need for mechanical cooling. External elements like trees or green spaces can also provide natural cooling and improve air quality. By considering these factors and implementing a well-designed natural ventilation system, it is possible to enhance indoor air quality, reduce reliance on mechanical cooling systems, and achieve a more sustainable and comfortable indoor environment.

Absolutely, the use of solar panels is an effective technology in achieving thermal comfort and reducing energy consumption in buildings. Solar panels, also known as photovoltaic (PV) panels, harness sunlight and convert it into electricity. They can be used for various purposes, including generating electricity and heating water, which can contribute to the overall comfort of the building while reducing reliance on conventional energy sources.

### **Here's how solar panels can help in achieving thermal comfort:**

**Electricity generation:** Solar panels can generate electricity to power various appliances and systems within the building. This includes lighting, fans, air conditioning, and heating systems. By utilizing solar energy, the building can reduce

its dependency on electricity from the grid, thereby reducing energy costs and environmental impact.

**Heating water:** Solar thermal panels, also known as solar water heaters, use sunlight to heat water. This can be utilized for domestic hot water needs or for radiant heating systems. By using solar energy to heat water, the building can reduce the consumption of fossil fuels or electricity traditionally used for water heating, thereby reducing energy costs and carbon emissions.

**Net metering and energy storage:** Excess electricity generated by solar panels can be fed back into the grid through a process called net metering. This allows the building owner to receive credits or financial compensation for the surplus energy produced. Additionally, energy storage systems, such as batteries, can be used to store excess electricity generated during the day for later use, ensuring a continuous and reliable power supply. **Renewable and clean energy:** Solar energy is a renewable and clean source of energy. By utilizing solar panels, buildings can reduce their carbon footprint and contribute to the mitigation of climate change. This aligns with sustainable development goals and promotes environmental responsibility.

It's important to note that the design, placement, and sizing of solar panels should be carefully considered to maximize their effectiveness. Factors such as the building's location, orientation, shading, and energy requirements should be taken into account during the planning and installation process.

Overall, incorporating solar panels in building design can contribute to achieving thermal comfort, reducing energy costs, and promoting sustainability. the use of refrigerated and heated ground systems is an innovative approach to achieving thermal comfort inside buildings while reducing reliance on traditional heating and cooling systems. These systems involve the integration of pipes or tubes within the flooring structure to circulate either chilled or heated water, providing a comfortable indoor environment.

Here's how refrigerated and heated ground systems can enhance thermal comfort:

**Cooling in summer:** In hot climates, the use of refrigerated flooring systems can help cool the indoor environment. Cold water circulates through the pipes embedded in the floor, effectively absorbing excess heat from the room. This can provide a

pleasant cooling effect and reduce the need for air conditioning, thus saving energy and lowering electricity costs.

**Heating in winter:** Similarly, heated flooring systems can provide warmth during colder seasons. Warm water circulates through the pipes, transferring heat to the floor surface. This radiant heating method helps warm the room from the bottom up, creating a comfortable and cozy environment. It reduces the reliance on conventional heating systems, such as radiators or forced-air heating, and can lead to energy savings.

**Uniform temperature distribution:** Refrigerated and heated ground systems promote more even temperature distribution within the space compared to traditional heating and cooling methods. As the floor is in direct contact with occupants' feet, the comfort level is enhanced, as cold or warm surfaces can affect overall thermal perception. This can reduce the need for additional heating or cooling sources, resulting in energy efficiency.

**Reduced air movement and allergens:** Since refrigerated and heated ground systems rely on radiant heating and cooling, they can minimize air movement within the space. This reduces the circulation of allergens, dust particles, and pollutants, promoting better indoor air quality and providing a healthier environment.

It's important to note that the design and installation of refrigerated and heated ground systems should be done by professionals to ensure proper functionality and performance. Factors such as insulation, control systems, and energy sources should also be considered to optimize their effectiveness and efficiency.

In summary, the use of refrigerated and heated ground systems can enhance thermal comfort, reduce energy consumption, and contribute to a sustainable and comfortable indoor environment. **Natural ventilation in buildings** refers to the process of using natural airflow to provide fresh air and remove stale air from indoor spaces. It involves the strategic design and placement of openings, such as windows, doors, vents, and skylights, to facilitate the movement of air. By harnessing natural forces like wind pressure, temperature differences, and the stack effect, natural ventilation can help maintain a comfortable and healthy indoor environment. **Passive Design:** Natural ventilation is often incorporated as part of passive building design

strategies. The building's orientation, layout, and window placement are carefully considered to maximize the intake of fresh air and promote air circulation.

**Cross-Ventilation:** Cross-ventilation is a common approach in natural ventilation. It involves positioning windows on opposite sides of a building or space to allow for the flow of air. This facilitates the exchange of indoor and outdoor air, improving indoor air quality.

**Ventilation Openings:** Properly sized and positioned ventilation openings, such as windows and vents, play a crucial role in natural ventilation. They allow for the intake of fresh air and the expulsion of stale air. The location and size of these openings are determined based on factors like prevailing winds, local climate, and building usage. **Stack Effect:** The stack effect is a natural phenomenon where warm air rises and creates a pressure difference, drawing in cooler air from lower openings. By designing buildings with high and low-level openings, the stack effect can be utilized to enhance natural ventilation.

**Control Strategies:** Natural ventilation can be further optimized through the use of control strategies. These strategies include adjustable windows, dampers, and sensors that respond to temperature, humidity, and air quality to regulate the airflow based on the occupants' needs and comfort. Benefits of natural ventilation in buildings include improved indoor air quality, reduced energy consumption (as it reduces the need for mechanical ventilation or air conditioning), and a connection to the outdoor environment. However, it's important to note that natural ventilation may not be suitable for all buildings or climates. Factors such as noise, pollution, security, and extreme weather conditions need to be considered in the design process. Proper sizing and placement of ventilation openings, along with the consideration of local climate patterns, are crucial to achieving effective natural ventilation in buildings.

### **Conclusion:**

In conclusion, building technology plays a crucial role in achieving thermal comfort within buildings. Various strategies and techniques can be employed to optimize the thermal performance of buildings and create a comfortable indoor environment. Here are some key points:

**Insulation:** The use of high-quality insulation materials in walls, roofs, and floors helps prevent heat transfer and minimize energy loss, resulting in improved thermal comfort and reduced energy consumption.

**Efficient HVAC Systems:** Advanced heating, ventilation, and air conditioning (HVAC) systems with precise temperature control, energy-efficient components, and smart controls allow for better regulation of indoor temperatures, ensuring optimal thermal comfort.

**Natural Ventilation:** Incorporating design elements that facilitate natural ventilation, such as strategically placed windows, vents, and operable skylights, promotes the exchange of fresh air and helps maintain a comfortable indoor environment while reducing reliance on mechanical cooling systems.

**Solar Shading:** Implementing shading devices, such as awnings, overhangs, or blinds, can block direct sunlight and prevent excessive heat gain, thus reducing the need for cooling and improving thermal comfort.

**Building Orientation:** Properly orienting buildings to take advantage of natural light and prevailing winds can optimize thermal comfort. Designing buildings to minimize exposure to extreme heat or cold can significantly improve occupants' comfort.

**Smart Controls and Automation:** Utilizing smart building technologies and automation systems allows for real-time monitoring and control of indoor temperature, humidity, and airflow. This helps adapt to changing conditions, optimize energy use, and enhance occupants' comfort.

**Renewable Energy Integration:** Incorporating renewable energy sources, such as solar panels or geothermal systems, can provide sustainable and clean energy for heating, cooling, and powering buildings, reducing reliance on fossil fuels and improving overall thermal comfort.

By integrating these building technologies and strategies, it is possible to create energy-efficient, comfortable, and sustainable indoor environments. Building design, materials selection, and efficient systems play a vital role in achieving thermal comfort while minimizing energy consumption and environmental impact.

Ultimately, prioritizing thermal comfort in building technology leads to healthier, more productive, and enjoyable indoor spaces for occupants.

### References:

- Abu El-Enein, H. S. A. (1989). The Origins of Climate Geography

Foundation of University Culture, Alexandria, p. 17

-Bayan Ahmed Osman, Smart solutions in buildings and their impact on the elements of architectural and structural design, IOSR Journal of Mechanical and Civil Engineering May- Jun. 2016

- Omar, M. I. (2010). Introduction to Environmental Sciences. Dar Al-Kutub Al-Alami for Publishing and Distribution, 3rd edition,

Cairo, p. 32.

-Foundation of University Culture, Alexandria, p. 17.

[6] Al-Wakeel, S. A, & Siraj, M. A. (2016). Climate and architecture of hot regions. 4th edition.

-Sustainable Building Design and Construction - A Guide to Building Energy-Efficient Homes: This guide, published by the U.S. Department of Energy, covers various energy-efficient building technologies and strategies, including those related to thermal comfort. (<https://www.energy.gov/eere/buildings/downloads/sustainable-building-design-and-construction-guide-building-energy-efficient>)

-Journal of Building Engineering: This academic journal focuses on research and innovations in building engineering, including topics related to energy efficiency, thermal comfort, and sustainable building technologies. (<https://www.journals.elsevier.com/journal-of-building-engineering>)

- Jalool. A. (nd). Elements of environmental architecture design and its role in sustainable development in desert areas (case study of the city of Sakra) - Master thesis, Algeria -2014- University of Mohamed Khader Biskra - Institute of Science and Technology - Department of Architecture.

-house in Malaysia, Proceedings in the 24th Conference on Passive and Low Energy Architecture, University of Singapore,

259-266.

- Tombazis A.N. & Preuss, S. A. (2001). Design of passive solar buildings in urban areas. *Journal of Solar Energy*, 70(3), 311-318.

-Yong, H. L. (2006). Home buyers requirements for housing development within districts in Selangor, Unpublished M.Sc Dissertation. Johor Bahru: The Universiti of Technology Malaysia.

-Zaki, W. R. M., Nawawi, A. H. & Sh. Ahmad, S. (2007). Case study in passive architecture: energy savings benefit in a detached

-Zaki, W. R. M., Nawawi, A. H. & Sh.Ahmad, S. (2008). Energy savings benefit from passive architecture, *Journal of Canada*

*Centre of Science Education*, 3, 51-63.