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## ZERO ENERGY BUILDING

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Today I want to touch on the topic of buildings with zero energy consumption and why they need to be designed and built now.

In the residential segment across India, the present electricity consumption is about 25 % of the total electricity consumption according to data published (2018–19). The electricity demand in residential buildings is at a simple annual growth rate of 10–14 %. This is because of the increasing population of economic and technological developments. To ensure that energy usage does not become unmanageable, which now poses a present-day challenge, the issue also provides an opportunity to address and resolve energy management problems in different areas.

It was concluded that HVAC (heating, ventilation, and air conditioning appliances) and gadgets driven by electrical motors consumed 36 % and 61,9 % of the total energy supplied The electrical energy consumption at the Airport, in Egypt, was analyzed by considering various indoor parameters such as temperature, illumination, and relative humidity. It was shown that there was a 24,5 % reduction in total energy consumption by increasing the air cooler temperature by 2 °C[1].

This study and analysis were carried out in a detailed manner with simulation studies and cost analysis. It was observed that the output was not meeting the nZEB (net-zero energy building) criteria; hence, the inclusion of renewable sources has been done with additional cost [1].

A large amount of money can be saved in the long run by maximizing the energy efficiency of a residential unit. The usage of energy-efficient devices could help us reduce the cost of energy consumption having the same power output.

It has been observed that the structure of the building and the selection of device are more significant in the power consumption.

The energy consumption purely depends on the architecture with the design and the maintenance due to the usage of the devices. Lighting and thermal play a vital role in energy consumption patterns. From such perspective of home heating, it can be seen that residential buildings have become the key to energy end users, and the importance of building energy conservation is becoming more and more significant [2]. With the continuous popularization of the concept of green, circular, and low-carbon development, "consumption" will be medium and long-term goal of my country's development, because it has comfort and will be the solution to climate warming. Lack of energy, an important architectural form that responds to people's high pursuit of quality of life and high quality, has attracted more and more attention from my country's construction industry and related scientific research institutes [2].

The cost of energy-saving and economic benefits are selected, and the energy-saving contribution rate and economic benefits are calculated. Finally, through the comparative analysis of design and test data, the differences and reliability for such design, are obtained.

Such consumption residential demonstration in a severe cold area is selected detailed energy consumption, economic calculation as well as optimization analysis is carried out for the multiperformance parameters in the planning stage, and the design value and the actual test results are compared and analyzed.

*Software Selection*. The choice of software is an important way to realize the research of the thesis. The correct choice of software can not only simplify the research, but also make the research results more accurate [1].

EnergyPlus can calculate the cooling and heating load of the building according to the physical composition and mechanical system of the building (HVAC system), which maintains the indoor set temperature through the HVAC system. EnergyPlus can also output very detailed data, such as solar radiation heat gain through windows, to verify with real data.

EnergyPlus is a software for cooling and heating load simulation and energy analysis. Based on the user's description from the physical model of the simulated object, the HVAC system, the control system, etc., EnergyPlus calculates the energy consumption as the amount of cooling necessary to maintain the temperature control setpoint, taking into account all HVAC systems. Heat loads, equipment loads, and many other simulations are performed with the aim to match what would be expected in the actual building.

The Technical Standard for Near-Zero Energy Consumption Buildings defines zero energy building as a building that adapts to climate characteristics and natural conditions, reduces the heating and cooling demand of buildings to the maximum extent, improves the efficiency of energy equipment and systems to the maximum extent through passive technical means, makes full use of the building itself and the surrounding or purchased renewable energy, and makes the annual energy supply of renewable energy greater than or equal to the total energy consumption of the building [2]. Generally, high-performance thermal insulation mate-rials and door and window components are used for the envelope structure to improve the thermal insulation performance. Although they help to reduce energy consumption, they will also increase the initial cost of the building and lead to an increase in the total cost. It is necessary to fully consider various technical parameters in the building design. If the thermal insulation thickness is too small, it will increase it and increase the energy consumption. However, the thermal insulation thickness is not as large as possible. Excessive thermal insulation thickness will lead to an increase in the cost, and the thermal insulation effect will not necessarily be greatly improved [3].

**Basic Equations for Energy Simulation**. Since EnergyPlus is an integrated synchronous solution of the Building Module, Air Module, and HVAC System Module, it is a synchronous simulation software. In order to obtain more realistic simulation results, EnergyPlus introduced the regional air heat capacity method in the heat balance calculation. The zone air heat capacity method refers to the zone temperature at the last time step to predict the system response and changes the time step. EnergyPlus calculates building energy consumption according to the first law of thermodynamics and calculates the instantaneous load of the room through the law of energy conservation [3].

The construction plan set out in the present paper does not mean specific cost analysis because cost analysis involves the impact of labor costs, construction technology, and local material price fluctuations. Identifiable cost issues can be further analyzed on a case-by-case basis. Finally, the contradiction between building energy consumption and indoor environment is closely related to related climate characteristics and renewable energy. We will continue to explore the application and benefits of renewable energy in energyefficient buildings in the next study.

## References

1. Exploring the Properties of Fiber Reinforced Concrete. Submitted by Rita Bagala, Lauren Fraser, RiAnna May. Worcester Polyethnic Institute, 2018.

2. R. Yao, K. Steemers and B. Li. Introduction to sustainable urban and architectural design. *Introduction to Sustainable Urban and Architectural Design*. China Architecture and Building Press, Beijing, China, 2016, pp. 1–272.

3. E. Forte, A. Kulkarni, J. Burger, M. Bortz, K.-H. Küfer and H. Hasse. Multi-criteria optimization for parametrizing excess Gibbs energy models. OSF Preprints, 2021, vol. 46, no. 8, pp. 135–140.