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SMART CITIES
ENERGY SIMULATION OF HIGH PERFORMANCE GREEN BUILDINGS
FOR ENERGY AND GREEN BUILDING SPECIALISTS
KRISHNAJI PAWAR,LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
ENERGY SPECIALIST CURRICULUM

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PASSIVE ARCHITECTURE
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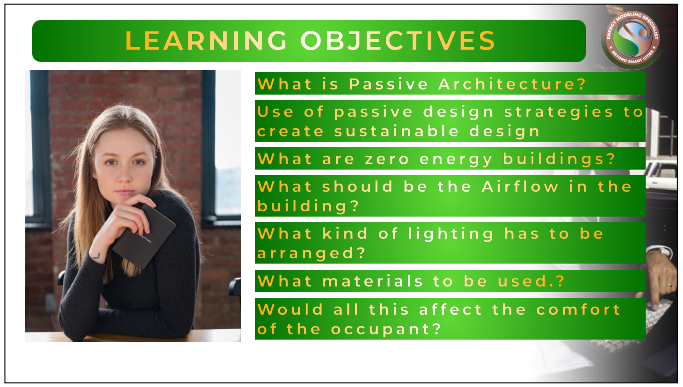

LEARNING OBJECTIVES
What is Passive Architecture?
Use of passive design strategies to create sustainable design
What are zero energy buildings?
What should be the Airflow in the building?
What kind of lighting has to be arranged?
What materials to be used.?
Would all this affect the comfort of the occupant?

WHAT IS PASSIVE ARCHITECTURE?

Passive Architecture involves blending conventional architectural principles with solar & wind energy and the inherent properties of building materials to ensure that the interiors remain warm in winter and cool in summer, thus creating a year-round comfortable environment.

To increase the energy efficiency of a building, a variety of active and passive design strategies can be incorporated. Active strategies usually consist of heating and cooling systems, while passive design measures include building orientation, air sealing, continuous insulation, windows and daylighting, and designing a building to take advantage of natural ventilation opportunities.

"Passive measures find ways to reduce the size of the heating and cooling system by keeping the heat (or cooled air) inside the building,"

"Passive design strategies take advantage of natural energy opportunities as they relate to the location of the building's site, the local climate (and the site's microclimate, if relevant), and the properties of building materials,"

USE OF PASSIVE DESIGN STRATEGIES TO CREATE SUSTAINABLE DESIGN

Passive designing, as old as the tale of mankind, is the designing of spaces that naturally tackle the problems of heat, ventilation, and energy consumption. It considers the natural air movement, energy, and light to warm and cool the building concerning the behavior of the surrounding natural environment.

Climate change is the primary design problem of our time. Our buildings consume nearly 60% of energy annually and emit around half of the carbon dioxide through the development of greenfields, cement production, and the emission of construction and demolition waste (C&D waste).

CO2 is a prime cause of global climate change because of its ability to trap solar energy in the atmosphere, thereby heating the planet. The construction industry is a vital polluter, particularly in India. With unregulated construction norms, this industry is a colossal contributor to pollution, affecting lives on a global scale. With the changing nature of the climate, Architecture too must change.

The key aspects of passive solar design are: thermal mass, insulation, angle and direction of the sun (orientation), windows (placement and operable), overhangs and shading, ventilation and circulation, surface colors, and geographical location

WHAT ARE ZERO ENERGY BUILDINGS?

Nearly zero-emission building (NZEB) means a building that has a very high energy performance, while the nearly zero or very low amount of energy required should be covered to a very significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby.

According to the directive's proposal, a zero emission building is defined as a building with a very high energy performance, with the very low amount of energy still required fully covered by energy from renewable sources and without on-site carbon emissions from fossil fuels.

In reality, however, the net-zero target is challenging. Homes and other structures that create almost as much energy as they use are sometimes called near-zero energy buildings. Nevertheless, it's possible for a building to produce an energy surplus, sending excess back to the electrical grid. Facilities or homes that produce more energy than they use are known as energy-plus buildings. Buildings that supply all their own energy and are not connected to an external source are described as off the grid.

USING NATURAL VENTILATION FOR SUSTAINABLE CONSTRUCTION

Natural ventilation is a healthy and cost effective way to save energy and provide fresh air for building occupants. It is defined as using passive strategies to supply outdoor air to a building's interior for ventilation and cooling without using mechanical systems. Natural ventilation has become a key component of green building today and is required in order to be certified by LEED and other GREEN Building.

The primary purpose of natural ventilation is to allow the outside ambient weather to provide low humidity, moderate temperature wind currents as an alternate cooling source for the building and provide air circulation throughout. By using this method, building owners are able to save on energy costs by turning off the HVAC system when the temperatures are right. Natural ventilation can replace all or part of a mechanical system—reducing construction, energy and operating costs for the owner.

According to LEED, the intent of natural ventilation is to "provide mechanical or natural ventilation systems that result in improved occupant comfort over conventional designs, increasing occupants' well-being and productivity while reducing energy consumption of ventilations systems." Naturally ventilated spaces must follow the terms defined by ASHRAE 62.1.

BUILDING ORIENTATION

Finding the right combination of active and passive strategies to incorporate into a project comes down to balancing the budget, program and the specifics of the site and microclimate. "Passive design depends a lot on the way the building is orientated," Our experience says. "So, the most successful energy-efficient designs are facing south or north to allow better solar energy management."

Orientating a building to take advantage of how the sun moves across the sky is the easiest and most effective passive design strategy. "We know that the same free heat streaming through windows in the winter can sabotage comfort in summer—unless it is considered in the design," Our experience explains "Overhangs, exterior shades and deciduous trees can help keep summer sun out while thermal mass—like a concrete floor or wall—inside the building can store winter heat."

An elongated and narrow building footprint allows for more of the building to be daylight. "This is usually the best form for passive design in terms of massing. The building can be designed as a single or multi-story, but the long, south or north facing façade facing is the key element of good passive design,"

DAYLIGHTING

The climate in which a building is located may dictate the type of windows needed. Pawar notes that in hot climates, the goal is to keep heat out of the building, so windows may have low-E coatings that exclude radiant heat and/or lower solar heat gain coefficients (SHGC).

Building orientation and exterior shading options are important considerations when locating windows and glazing. "It can be more difficult to control direct solar heat gain and glare at skylights, but it helps to orient skylights to maximize daylighting from the north."

"Typically north-facing glazing is best for quality daylighting, but daylighting strategies can also be very effective for south-facing glazing (and can help for west and east-facing glazing as well)."

"It's very important to use advanced window systems and technologies, including cutting-edge glazing and coatings that are available today,"

It's also important to understand the impact of natural light, heat gain and glare on building systems design. By coordinating the massing of the building, location of windows and daylight harvesting with mechanical and electrical design, engineers can downsize the building systems and match the high efficiency goals of the project.

INSULATION MATERIALS

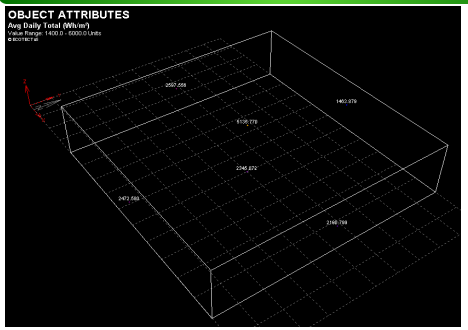
Adding insulation to a building is another passive design strategy. "What is required by energy code in terms of insulation is usually just the bare minimum,"

"Designing a building envelope above the mere code requirement in terms of adding extra insulation is always a good passive design strategy. If a building is designed properly, the extra money invested in better insulation, better windows and a better roof, will result in a reduction of the cost of the mechanical and electrical systems and a passive design structure."

"Typically north-facing glazing is best for quality daylighting, but daylighting strategies can also be very effective for south-facing glazing (and can help for west and east-facing glazing as well)."

Insulation is particularly important for buildings in colder climates. "Insulation helps the building envelope to resist the conductive flow of heat, and it is typically most effective when installed as continuous insulation (which significantly reduces thermal bridging as compared to cavity insulation),"

SOLAR INSULATION IN BENGALURU



METAL BUILDING PRODUCTS

Metal building systems and metal construction products can be used to aid in passive design strategies.

"Metal building systems can be particularly effective when integrated with the building envelope to create strategically placed exterior shading,"

"Metal roofs can act as radiant barriers, which can significantly cut the amount of work that the insulation needs to do. Because most of the heat that hits a building hits the roof, this can effect the amount of insulation needed and can free up some budget for upgrades in other places."

"Passive building targets are an energy balance and performance-based set of criteria to reduce heating and cooling as the primary energy saving strategy,"

Using 3-D modeling early in the design process can be very helpful in informing the design team on what passive design strategies will likely have the most impact on creating a highly energy-efficient building envelope.

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