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Energy Conservation in Building Construction

M.V. Molykutty
B.S. Abdur Rahman University, Chennai, India
E-mail: mvmoly@bsauniv.ac.in

IMPORTANCE OF ENERGY

Energy is the ability to do work. Energy intensity is a measure of the energy efficiency of a nation's economy and is calculated as units of energy per unit of Gross Domestic Product. There are different forms of energy like chemical, mechanical, electrical, thermal, magnetic, nuclear, etc. Most commonly, we use energy in the form of electrical energy. Generally energy is produced from fossil fuels but their resources are limited. They also cause pollution due to the release of CO_2 during energy production process. Hence, we should reduce our dependence on fossil fuels for production of energy and should find innovative methods to make use of renewable sources of energy.

ENERGY AND BUILDINGS

Energy is a fundamental component of construction process. As population increases, number of buildings also increases and so is the related energy usage. There are two categories by which a building consumes energy. They are embodied energy and operational energy. Embodied energy is the energy consumed by the building for the production of the building. They include manufacturing of materials and equipment, the transport of the materials. It is classified under initial embodied energy. The use of energy for repair, maintenance and destruction comes under recurring embodied energy. Operational energy is the energy required for the building service for the entire life time of the building. It includes energy required for heating, ventilation, air conditioning, lighting and other household purposes.

ENERGY AND POLLUTION

Having seen the role of buildings in the usage of energy, we will see the consequences of it. The release of CO_2 causes global warming, sea level rise, and climate change. We know that every unit of electricity produced causes 2.17 pounds of CO_2. Hence, buildings are major components causing global warming. One of the ways of reducing these ill effects, as a civil engineer is through demand side management by way of reducing the energy demand by properly planning and designing the building or by adoption of passive architecture. It is estimated that buildings are responsible for about 40% of total energy consumption. But the silver line is that there is a huge potential for energy conservation in this sector by adopting energy efficient building materials and methods.

ENERGY CONSERVATION METHODS IN BUILDINGS

Having understood the importance and consequences of energy usage, it is civil engineers duty to reduce the energy usage of buildings by proper planning, using energy efficient materials and processing and construction methods. Passive architecture plays a very important role in this context by means of which energy use can be reduced for space heating and space cooling. In passive design we plan the components of building like walls, fenestration, roof etc. of the building in such a way that during summer the temperature is reduced inside and during winter temperature is increased inside the building compared to the outside and we make use of natural lighting instead of

artificial electric lights and natural ventilation instead of air conditioning. Sometimes a hybrid system is used to act as stand by. Proper orientation, proper ventilation and shading, proper materials for the body of the building, wind tower, thermal mass and other innovative methods are to be incorporated for this purpose. Innovative cheap materials and methods are to be evolved at by doing research. Remember that one unit of energy conserved is equivalent to one unit of energy produced. We have now witnessed the consequences of global warming and climate change at Chennai flood, Tamil Nadu, India. Rainfall equivalent to one month is received in a single day and it made life miserable everywhere at Chennai. If we analyze the root cause we end up in ourselves. So it is our benign duty to protect the environment and hand over it safe to our younger generations with the concept that we are not the owners but only the trustees of the universe.

BUILDING ENERGY PERFORMANCE SIMULATION

Now the performance of a building can be studied by modeling the energy transfer between a building and its surroundings. It enables one to determine the effectiveness of the design of a building and help in evolving improved designs for energy efficient buildings with comfortable indoor conditions. It consists of mathematical and thermodynamic algorithms that are used to calculate the energy performance according to the model of the simulation engine. The data required to study the thermal performance of a building is shown in Figure 1

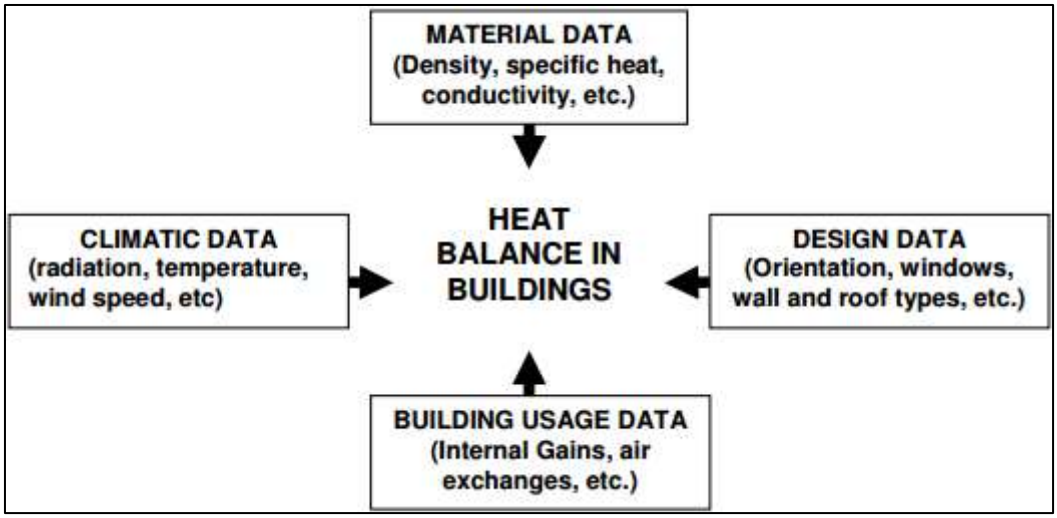

Fig. 1. *Data Required to Study the Thermal Performance of a Building (http://mnre.gov.in/solar-energy/ch4.pdf).*

A number of computer simulation tools are now available to do quick and accurate assessment of a building's thermal and daylighting performance. These tools estimate the performances of different designs of the building for a given environmental condition from which a designer can choose the one that consumes minimum energy. Thermal calculations not only help new designs but also help to select appropriate retrofits for existing buildings with minimum energy usage. Thus, by integrating the simulation of thermal performance of a building with its architectural design, an energy efficient building can be arrived at.

Some of the tools are DOE-2.1E which predicts the hourly energy use and energy cost of a building. EnergyPlus is a modular, structured software tool for accurate temperature and comfort

prediction. eQUEST is another tool for energy simulation modeling. TRNSYS is another commercially available simulation tool. Ecotect, Revit architecture are also used for simulation. A number of simulations tools in alphabetical order are available (www.buildingenergysoftwareto ols.com). The result of simulation depends on the quality of input given. So it is very important to give reliable data for simulation. It is hoped that simulation tools will play a very important role for energy conservation in buildings and in turn for pollution reduction in future.

