

## ENERGY CONSERVATION IN CONSTRUCTION INDUSTRY THROUGH MATERIALS AND TECHNIQUES

JIVIC J PANACKAL & SANDEEP KUMAR M D

Department of Civil Engineering Ahalia School of Engineering and Technology Palakkad, Kerala, India

### ABSTRACT

The building industry is constantly expanding with consequences on energy expenditure. As similar to the most countries, in India too building industry is the most Energy consuming Industry. In recent years there were much discussions regarding Energy conservation techniques to mitigate the demand side of the energy sector. Building design directly affects the energy performance of the building. The emphasis on energy Conservation has therefore, to begin at the design stage & control throughout the life cycle (Design, Construction, Operate and Maintenance) of the building project. Not only building design but also materials and techniques has great role in energy conservation in construction industry.

It is just not possible to continue to build with traditional materials and achieve sustainable development as well as more energy efficient. In India, the projected population by 2026 will be 1400 million. By 2016 just 10 years away, it is estimated that the housing shortage will touch 90 million. In this paper we mainly focused about five materials which help in energy conservation in construction industry. The first one is energy star windows, doors and roofs. It is a government-backed labeling program that helps people and organizations save money and reduce greenhouse gas emissions by identifying factories, office equipment, home appliances and electronics that have superior energy efficiency.

The next material is GFRG panel. GFRG panels or Rapid wall is a load bearing building panel with a multiple uses for the construction industry. It is ideal for just about any construction in which current building practices are used and is suitable for single, double or multi storey housing and for commercial and industrial development. Rapid wall eliminates the needs for bricks, timber, wall frames and plaster boards as it serves as both the internal and external load bearing wall

The third one is Tank less water heaters. They are also called instantaneous, continuous flow, inline, flash, on-demand, or instant-on water heaters are gaining in popularity. These high-power water heaters instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil.

The fourth material is programmable thermostat. A programmable thermostat is a thermostat which is designed to adjust the temperature according to a series of programmed settings that take effect at different times of the day. Programmable thermostats may also be called setback thermostats or clock thermostats.

The last material is Solar Panels. Solar energy is clean and renewable source of energy. Solar panels are an emerging and hot technology for people who want to utilize the natural power all around us, the sun. Solar panels may be expensive at first, but the long-term savings you can put into your pocket is a stunning example of the benefits of turning your life from black to green. The location of your house and the way you have constructed solar panels can determine how much power you can collect. By taking advantage of solar power you can bring down your energy consumption and supply excess energy, if any, to your utility company. Also, government grants, incentives and tax breaks are huge bonus

to those who want to use solar power in their home.

**KEYWORDS:** Energy Star Windows, Energy Star Door, Energy Star Roof, Gfrg Panels, Tank less Water Heater, Thermostat, Solar Panels

## **INTRODUCTION**

In recent years, the number of buildings constructed using energy-saving designs has increased due to the increasing awareness of the benefits of energy conservation, both economic and environment. The recent rapid advances in computer technology have facilitated the development of energy-saving building designs by allowing detailed stimulations, involving the incorporation of many energy-saving building techniques and features, to be conducted in the design stage. These techniques have been widely studied in terms of their design potential, however, there are very few studies concerning the actual post-construction performance of the design features and whether the overall building design does in fact provide significant energy savings. First one is

It is just not possible to continue to build with traditional materials and achieve sustainable development as well as more energy efficient. In India, the projected population by 2026 will be 1400 million. By 2016 just 10 years away, it is estimated that the housing shortage will touch 90 million. Energy conservation refers to reducing energy consumption through using less of an energy service. Energy conservation differs from efficient energy use, which refers to using less energy for a constant service. For example, driving less is an example of energy conservation. Driving the same amount with a higher mileage vehicle is an example of energy efficiency. Energy conservation and efficiency are both energy reduction techniques. Even though energy conservation reduces energy services, it can result in increased environmental quality, national security, personal financial security and higher savings. It is at the top of the sustainable energy hierarchy. It also lowers energy costs by preventing future resource depletion. In order to overcome this huge housing shortage is an urgent need for alternative building techniques and materials.

In this, we introduce some of the recent building materials in order to achieve the goal of conservation of energy in building construction industries.

## **ENERGY STAR WINDOWS, DOORS AND ROOFS**

It is a government-backed labeling program that helps people and organizations save money and reduce greenhouse gas emissions by identifying factories, office equipment, home appliances and electronics that have superior energy efficiency. In recent years, Energy Star ratings have been extended to some new homes, commercial and industrial facilities. Energy Star originated in 1992 as a joint program of the U.S. Environmental Protection Agency (EPAM) and the U.S. Department of Energy (DoE). In 2007, the European Union adapted Energy Star, including related standards, for all of its members. Australia and New Zealand has already adopted the program. As a result, the Energy Star symbol has become the international symbol for energy efficiency.

Adoption of energy efficient practices are an important component of the green computing movement, both in terms of lower operating costs and reduced pressure on the energy grid. This in turn over time reduces, if not halts, the growth in greenhouse gasses emitted by coal-fired energy plants. These gases, according to recent reports from the Intergovernmental Panel on Climate Change are the major component in the rapid warming of the Earth over the past century, a development which has potentially disastrous results for both humans and ecosystems in general worldwide.

## ENERGY STAR CERTIFIED WINDOWS AND DOORS

Comes in a variety of framing materials:

- **Fiberglass** frames are strong, durable, low maintenance, and provide good insulation. Fiberglass frames can be either hollow or filled with foam insulation.
- **Vinyl** frames are low maintenance and provide good thermal insulation. Sections may be hollow or filled with foam insulation. Wide vinyl sills may be reinforced with metal or wood.
- **Aluminum** frames are durable, low maintenance, recyclable, and typically have at least 15% recycled content. Frame design typically includes thermal breaks to reduce conductive heat loss through the metal.
- **Wood** frames are strong, provide good insulation, and are generally favored in historical neighborhoods. The exterior surfaces of many wood windows are clad (or covered) with aluminum or vinyl to reduce maintenance.
- **Combination** frames use different materials separately throughout the frame and sash to provide optimal performance. For example, the exterior half of a frame could be vinyl while the interior half could be wood.

Composite frames are made of various materials that have been blended together through manufacturing processes to create durable, low maintenance, well-insulated windows.

### A. ROOFS

ENERGY STAR qualified roof products reflect more of the sun's rays. This can lower roof surface temperature by up to 50F, decreasing the amount of heat transferred into a building. ENERGY STAR qualified roof products can help reduce the amount of air conditioning needed in buildings, and can reduce peak cooling demand by 10-15 percent. Although there are inherent benefits in the use of reflective roofing, before selecting a roofing product based on expected energy savings consumers should explore the expected calculated results that can be found on the Department of Energy's "Roof Savings Calculator" Please remember the Energy Savings that can be achieved with reflective roofing is highly dependent on facility design, insulation used, climatic conditions, building location, and building envelope efficiency. Product submissions must include initial emissivity data for all existing and new products. All new products cannot be cleaned prior to the three year test. Reflectivity requirements differ for low-slope and steep-slope roofs. ENERGY STAR qualified roof products can help reduce the amount of air conditioning needed in buildings, and can reduce peak cooling demand by 10–15 percent.

### GFRG PANEL

GFRG panels or Rapid wall is a load bearing building panel with a multiple uses for the construction industry. It is ideal for just about any construction in which current building practices are used and is suitable for single, double or multi storey housing and for commercial and industrial development. Rapid wall eliminates the needs for bricks, timber, wall frames and plaster boards as it serves as both the internal and external load bearing wall. Rapid wall panels are manufactured in moulding process from high grade gypsum plaster and glass fibre rowings to a size of 12m by 3m by 123mm thick. The panels are cut in the factory to design specifications and are loaded in truck for transportation. With the help of small crane the panels are erected. The formed cells can be filled with insulation for increased thermal performance

or with concrete for increasing load bearing capacity. Rapid wall saves considerable time and money. As gypsum is a waste material obtained from the chemical factories, by using this gypsum for making GFRG panels, a large amount of such gypsum can be recycled.

Rapid wall is a single panel walling system that serves as both the internal and external wall and eliminates the need for bricks, blocks, timber and steel wall frames and plasterboard linings. It is the most ecologically sound and technologically advanced building product available in the world today.

Some of the application of GFRG panels are:

- They are used for load bearing walls in multi storey and domestic housing construction
- They are used for roof panels and for permanent form work, fencing, etc.
- It also provide more resistance against Earthquake and act as a good heat insulating materials

A house made using GFRG panels

## TANKLESS WATER HEATERS

Tank less water heaters also called instantaneous, continuous flow, inline, flash, on-demand, or instant-on water heaters are gaining in popularity. These high-power water heaters instantly heat water as it flows through the device, and do not retain any water internally except for what is in the heat exchanger coil. Copper heat exchangers are preferred in these units because of their high thermal conductivity and ease of fabrication.

Tank less heaters may be installed throughout a household at more than one point-of-use (POU), far from a central water heater, or larger centralized models may still be used to provide all the hot water requirements for an entire house. The main advantages of tank less water heaters are a plentiful continuous flow of hot water (as compared to a limited flow of continuously heated hot water from conventional tank water heaters), and potential energy savings under some conditions. The main disadvantage of these systems is their high initial costs (equipment and installation).

## ADVANTAGES AND DISADVANTAGES

For homes that use 41 gallons or less of hot water daily, demand water heaters can be 24%–34% more energy efficient than conventional storage tank water heaters. They can be 8%–14% more energy efficient for homes that use a lot of hot water -- around 86 gallons per day. You can achieve even greater energy savings of 27%–50% if you install a demand water heater at each hot water outlet. ENERGY STAR estimates that a typical family can save \$100 or more per year with an ENERGY STAR qualified tank less water heater.

The initial cost of a tank less water heater is greater than that of a conventional storage water heater, but tank less water heaters will typically last longer and have lower operating and energy costs, which could offset its higher purchase price. Most tanks less water heaters have a life expectancy of more than 20 years. They also have easily replaceable parts that extend their life by many more years. In contrast, storage water heaters last 10–15 years.

Tank less water heaters can avoid the standby heat losses associated with storage water heaters. However, although gas-fired tank less water heaters tend to have higher flow rates than electric ones, they can waste energy if they have a constantly burning pilot light. This can sometimes offset the elimination of standby energy losses when compared to

a storage water heater. In a gas-fired storage water heater, the pilot light heats the water in the tank so the energy isn't wasted.

## **PROGRAMMABLE THERMOSTAT**

A programmable thermostat is a thermostat which is designed to adjust the temperature according to a series of programmed settings that take effect at different times of the day. Programmable thermostats may also be called setback thermostats or clock thermostats.

Heating and cooling losses from a building (or any other container) become greater as the difference in temperature increases. A programmable thermostat allows reduction of these losses by allowing the temperature difference to be reduced at times when the reduced amount of heating or cooling would not be objectionable.

### **Clock Thermostats**

The most basic clock thermostats may only implement one program with two periods (a hotter period and a colder period), and the same program is run day after day. More sophisticated clock thermostats may allow four or more hot and cold periods to be set per day. Usually, only two distinct temperatures (a hotter temperature and a colder temperature) can be set, even if multiple periods are permitted. The hotter and colder temperatures are usually established simply by sliding two levers along an analogue temperature scale, much the same as in a conventional (non-clock) thermostat.

### **Digital Thermostats**

A touch-screen programmable thermostat in programming mode. Digital thermostats may implement the same functions, but most provide more versatility. For example, they commonly allow setting temperatures for two, four, or six periods each day, and rather than being limited to a single "hotter" temperature and a single "colder" temperature, digital thermostats usually allow each period to be set to a unique temperature. The periods are commonly labeled "Morning", "Day", "Evening", and "Night", although nothing constrains the time intervals involved. Digital thermostats usually allow the user to override the programmed temperature for the period, automatically resuming programmed temperatures when the next period begins. A function to "hold" (lock-in) the current temperature is usually provided as well; in this case, the override temperature is maintained until the user cancels the hold or a programmed event occurs to resume the normal program. More-sophisticated models will allow for the release of the hold to take place at a set time in the future.

### **Digital Thermostats with PID Controller**

More expensive models have a built-in PID controller, so that the thermostat learns how the system will react to its commands. Programming the morning temperature to be 21° C at 7:00 AM, for instance, makes sure that at that time the temperature will be 21 °C. A standard programmable thermostat would simply start working toward 21° at 7:00 AM. The PID controller decides at what time the system should be activated in order to reach the desired temperature at the desired time. It knows this by remembering the past behavior of the room, and the current temperature of the room. This is called optimal start.

### **Commercial Thermostats**

In commercial applications, the thermostat may not contain any clock mechanism. Instead, another means may be used to select between the "hotter" and "colder" settings. For example, if the thermostat uses pneumatic controls, a change

in the air pressure supplied to the thermostat may select between the "hotter" and "colder" settings, and this air pressure is determined by a central regulator. With electronic controls, a specific signal may indicate whether to operate at the "hotter" or "colder" setting.

## **SOLAR PANELS**

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating. A photovoltaic (in short PV) module is a packaged, connected assembly of typically 6×10 solar cells. Solar Photovoltaic panels constitute the solar array of a photovoltaic system that generates and supplies solar electricity in commercial and residential applications. Each module is rated by its DC output power under standard test conditions, and typically ranges from 100 to 365 watts. The efficiency of a module determines the area of a module given the same rated output – an 8% efficient 230 watt module will have twice the area of a 16% efficient 230 watt module. There are a few solar panels available that are exceeding 19% efficiency. A single solar module can produce only a limited amount of power; most installations contain multiple modules. A photovoltaic system typically includes a panel or an array of solar modules, a solar inverter, and sometimes a battery and/or solar tracker and interconnection wiring.

The price of solar power, together with batteries for storage, has continued to fall so that in many countries it is cheaper than ordinary fossil fuel electricity from the grid (there is "grid parity").<sup>[1]</sup>

## **CONCLUSIONS**

As we are leaving in modern world consist of much type of energy crises it is ower duty to conserve energy in construction industry through using materials and techniques. For this purpose we can use different type of materials such as GFRG Panels, Solar panels, thermostat, tank less water heaters, energy star windows, doors and roofs. Otherwise our nation will face large energy crises.

## **ACKNOWLEDGEMENTS**

We would like to thanks all our staff of civil department, who motivated and inspired us with their innovative ideas to write this paper; I would also like to thanks Dr Jino John (HOD) civil department ahalia school of engineering, Palakkad, kerala, who guided us to write this Research Paper, I also thanks prof. deeraj A D (Assistant Professor, civil department ahalia school of engineering, Palakkad, kerala ), who supported with her innovative ideas for writing this Research Paper. I would like to thanks, prof. Smitha (Assistant Professor, in civil department ahalia school of engineering, Palakkad, kerala), who supported with her innovative ideas for writing this Research Paper.

## **REFERENCES**

1. <http://www.conserve-energy-future.com/top-15-green-home-building-techniques-and-ideas.php>
2. <http://www.rapidwall.com.au/worldwide/india>
3. [https://en.wikipedia.org/wiki/Solar\\_panel](https://en.wikipedia.org/wiki/Solar_panel)
4. [https://en.wikipedia.org/wiki/Main\\_Page](https://en.wikipedia.org/wiki/Main_Page)