INTERNATIONAL JOURNAL OF PURE AND APPLIED RESEARCH IN ENGINEERING AND TECHNOLOGY

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SPECIAL ISSUE FOR
NATIONAL LEVEL CONFERENCE
"RENEWABLE ENERGY
RESOURCES & IT'S APPLICATION"

A VISION FOR SUSTAINABLE CONSTRUCTION: ZERO ENERGY BUILDING

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Accepted Date: 12/03/2016; Published Date: 02/04/2016

Abstract: A Zero Energy Building (ZEB) is a popular term to describe a building designed such that the use of nonrenewable resources is reduced to zero and sustainable sources like Solar, wind etc. are applied to generate electricity for house hold use. The concept further explains the utilization of maximum natural sources for ventilation, illumination, thermal resistivity, accusative effect etc. so as to reduce total consumption of energy required in home. As the concept is adopting sustainable sources and material this method or designing concept proves to be one of the strategy for sustainable growth and hence, in simple words it can be defined as 'Sustainable Construction Technology'. Zero energy buildings can be independent from the energy grid supply. Energy can be harvested on-site—usually through a combination of energy producing technologies like Solar and Wind—while reducing the overall use of energy with extremely efficient HVAC and Lighting technologies. The zero-energy design principle is becoming more practical to adopt due to the increasing costs of traditional fossil fuels and their negative impact on the planet's climate and ecological balance. Also Energy efficiency and solar energy technologies can result in zero net energy consumption from non-renewable sources. The concept of zero energy buildings (ZEB) has been around for a long time. A literal interpretation of zero-energy could be that of a building that operates without any external sources of energy, and we will assume that also refers to achieving comfortable indoor environmental conditions. The first obvious solution is that of an autonomous house, with no connection to any off-site energy sources. We think that the goals for achieving 'Zero Energy Buildings' are positive developments which are helpful for improving the entire building industry, however meeting the goals is going to require a lot of new design techniques, tools, and products. We hope to support your work in this area through our research and development efforts

Keywords: Concept of Zero Energy, Technical Design Concept, Materials used for Construction.

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Access Online On:

www.ijpret.com

How to Cite This Article:

Kashinath N. Zamare, IJPRET, 2016; Volume 4 (8): 438-449

PAPER-QR CODE

INTRODUCTION

There is a perfect storm of sorts brewing in the world of new construction. As building technology improves, architects have developed exciting passive designs to reduce energy needs in order to maintain temperature throughout the sun's daily and annual cycles while reducing the requirement for active heating and cooling systems. Next add to that the ever-improving performance of wind and solar generation while continuing to drive lower costs to implement. And finally, manufactures are engineering more energy efficient HVAC and home appliances to reduce consumption and increase efficiency. The intersection of these phenomena's is the Zero-Energy Building.

As defined by the INDIAN Department of Energy, "a net zero-energy building (ZEB) is a residential or commercial building with greatly reduced energy needs through efficiency gains such that the balance of energy needs can be supplied with renewable technologies." Basically the ZEB concept is the idea that buildings can meet all their energy needs from low-cost, locally available, nonpolluting, renewable sources such as local utility via the power grid. By using the grid to account for the energy balance, excess production can solar or wind power. That building can generate enough renewable energy on site to equal or exceed its annual energy use. A zero energy building typically uses traditional energy sources such as the electric and natural gas utilities when on-site generation does not meet the need. When the on-site generation is greater than the building's loads, excess electricity is sold to the offset later energy use.

The principles that have applied to develop this ranking are based on technologies that:

• Minimize overall environmental impact by encouraging energy-efficient building designs and Reducing transportation and conversion losses.

• Will be available over the lifetime of the building.

• Are widely available and have high replication potential for future ZEBs.

II. CONCEPT OF ZERO ENERGY BUILDING

Some of the guiding concepts in developing the ZERO ENERGY BUILDING technologies can be summarized as follows:

Energy conservation; Minimize the use of high energy materials; Concern for environment, environment-friendly technologies; Minimize transportation and maximize the use of local

materials and resources; Decentralized production and maximum use of local skills; Utilization of industrial and mine wastes for the production of building materials; Recycling of building wastes, and Use of renewable energy sources. Building technologies manufactured by meeting these principles could become sustainable and facilitate sharing the resources especially energy resources more efficiently, causing minimum damage to the environment.

Design Considerations

1. Planning:-

Sustainable site Planning:-

"A site plan that has the least environmental impact while still meeting the client's project goals." It's not sustainable if it only parks half the cars that the project needs and costs twice as much as budgeted. Just like any other design it has to be framed within the typical project parameters, but it also includes consideration of the environment.

Site Selection:-

Site selection can have a significant impact on the environmental impact of a project site. Some specific parameters to consider when selecting a site include:

- Avoid flood plains - continued development in natural flood plain areas has contributed to increased flooding, decreased flooding and increased soil loss.

- Provide buffers for bodies of water - Development around bodies of water such as streams and wetlands should be limited and include buffers of undisturbed areas of 50'-100' or more.

- Avoid green fields - Greenfields and brown fields are often less expensive to develop, place less stress on infrastructure and limit the environmental impact of developing previously undeveloped sites.

- Transportation - the impact that transportation of people and goods to a site has can be significant. Try to select sites that encourage the use of public and non-motorized transportation.

Site/Building Layout:-

The simple act of proper building orientation can create energy savings of up to 25%. As little as 8 degrees of rotation can have an impact. Consider the following when setting and orienting buildings.

- Elongate the plan on the east/west axis
- Maximize north and south exposure for day lighting
- Minimize east and west facing windows
- Orient most populated areas to the north and south

The above items are good general guidelines but keep in mind that extreme climates may warrant different practices. For instance in extremely cold climates limiting windows on the north side may create energy savings that outweigh the benefits of the day lighting that they provide.

Impervious Surfaces:-

Increasing the imperviousness of a site can have a tremendous effect on the water cycle. Impervious surfaces limit groundwater recharge, increase pollutant loads and runoff and create a heat island effect. It's important to limit the impervious areas on site to the minimum. Doing this often improves the aesthetic of the site, reduces the environmental impact and saves money. Below are some things to consider in order to reduce site imperviousness.

- Minimize parking areas
- Zoning code minimum or less
- Incorporate compact car spaces when possible
- Reduce lane sizes
- Provide plantings in and around parking areas
- Implement Green Roofs
- Implement pervious paving options
- Pervious pavement/asphalt

Grading Considerations:-

The environmental impacts of mass grading a development or building site are often overlooked. Site grading destroys the natural ecosystem present within the soil. This ecosystem provides systems to break down pollutants, provide nutrients for biota, support insect and animal life and numerous other benefits. It takes many years for the soil to recover from mass grading and sometimes it never does. There is also the temporary or permanent impact of soil erosion which pollutes waterways and washes valuable soil off site. Whenever possible we should try to limit grading operations to the distances beyond constructed items as shown below.

- < 10 feet beyond surface walkways, patios, surface parking, and utilities
- < 40 feet beyond the building perimeter
- < 15 feet beyond primary roadway curbs
- < 25 feet beyond constructed areas with permeable surfaces (pervious paving, storm water detention, and playing fields).

Landscape Design:-

Landscape design is often ignored in the initial planning stages and is tacked on at the end of the project. This is unfortunate and discounts the many benefits that proper landscape design can have beyond aesthetics. On the other hand, improper landscape design can have significant negative effects such as excessive potable water use and erosion. Listed below are a number of items to consider during the site planning.

- Limit potable water use
- Use Native Species
- Place landscape areas to receive runoff
- Use captured rainwater
- Shade large hardscapes
- Shade buildings in summer, allow sunlight in during winter
- Place and design landscape areas to filter and clean stormwater

- Raingardens in parking areas
- Bioretention rather than retention ponds

Orientation:-

Orientation of building is to design building in such a way as it receives maximum ventilation and natural light in all climatic conditions. It provides comfortable living conditions inside the house/building and saves energy bills also. The orientation can defend undesirable effects of worse weather. While planning to build a new house, ask your architect to design building in such a way that energy loss is minimum.

Climatic Implication

Orientation of building determines the amount of radiation the building receives. The orientation with respect to air patterns affects the amount of natural ventilation as much as possible.

Using the Sun advantage when orientate building

The fact the sun is lower in the sky in winter than in summer allows us to plan and construct buildings that capture that free heat in winter and reject the heat in summer. The orientation of the whole building plays an important part in ensuring such a 'passive' process works.

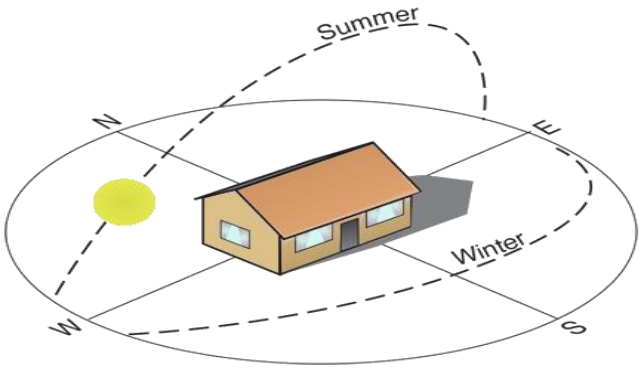

Fig. Showing the position of sun in winter and summer

Walls:-

A wall should not just be an enclosure. it provides far more than just protection from the element. An appropriately designed and constructed wall is the fundamental part of the home

and has far reaching impact on the health of the occupant. A properly designed wall should be designed to provide following benefits.

1. Self regulation of moisture year round
2. Storage of heat in winter and cool in summer
3. Radiant heating and cooling

Walls have two main impacts on a building's sustainability: firstly they are the biggest component of a building and generally have the most impact environmentally; secondly, most heat lost in a house is through the walls. The materials, their embodied energy, U values and transportation requirements are very important to the sustainability of the overall building.

Breathable walls are also very important as they help to stabilize the moisture content of the internal air, this can improve air quality for people who suffer from breathing related issues and also reduce the amount of bacteria and fungi that relish the highs and lows of realtive humidity. When building breathable structures it is important to note that the internal walls must be more resistant to water vapour than the outer ones. This means that water is constantly being drawn away from the interior. When using lime a good way of achieving this is to use hydraulic lime internal plasters and lime putty external renders. Eco-friendly wall Materials

Blocks made out of recycled materials:-

These blocks look like and are used in the same way the same as normal blocks. They are made from recycled materials including waste sludge ash from power stations.

Fig. Shows the bricks, made up of recycled material

Non-fired bricks:-

Bricks can be made and left to dry naturally. They only use 14% of the energy used to make normal bricks. These bricks are normally used for internal non-load bearing walls. They are breathable, light and provide good thermal insulation.

Recycled / re-used bricks:-

Bricks that have been used with a lime mortar, rather than cement, can be easily recycled and re-used. This greatly reduces the energy involved in manufacture.

Wood:-

Wood is a very versatile material and can allow us to build cheaply, quickly and efficiently. Timber also has the advantage that it absorbs carbon dioxide from the atmosphere when it is growing. Wood can be used for load bearing walls and for exterior walls. Certain woods, like Oak and Cedar, contain natural preservatives and so do not need treating with chemicals. The flexible nature of timber building means that we can create highly insulated structures

Fig . Shows the wooden frame structure

Passive solar building design:-

In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. This is called passive solar design or climatic design because, unlike active solar heating systems, it doesn't involve the use of mechanical and electrical devices.

The key to designing a passive solar building is to best take advantage of the local climate. Elements to be considered include window placement and glazing type, thermal insulation,

thermal mass, and shading. Passive solar design techniques can be applied most easily to new buildings, but existing buildings can be adapted or "retrofitted".

Green wall:-

A green wall is a wall, either free-standing or part of a building, which is partially or completely covered with vegetation and, in some cases, soil or an inorganic growing medium. The creator of a large green walls concept (vertical gardens) is the French botanist Patrick Blanc [1]. The vegetation for a green façade is always attached on outside walls; with living walls this is also usually the case, although some living walls can also be green walls for interior use. For living walls there are many methods including attaching to the air return of the building to help with air filtration. They are also referred to as living walls.

Fig. Shows system of green wall

Cavity Wall:-

The gap between the 'leaves' or walls of the building which was originally created to allow any rainwater that penetrates through the outside wall, to drain down the inside of the wall to below the damp proof course (dpc).

The cavity wall insulation works by trapping air in and around the material injected into the cavity and can reduce the heat lost from your home by 35%.

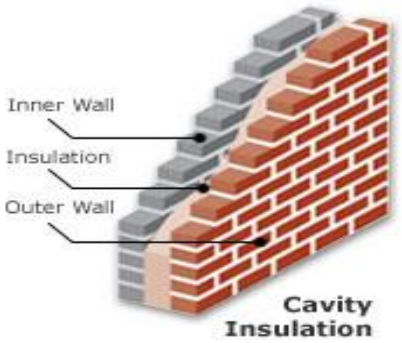

Fig. Shows the system of cavity wall

Fig. Shows the Eco friendly wall finishes

Green roof:-

A green roof is a roof of a building that is partially or completely covered with vegetation and a growing medium, planted over a waterproofing membrane. It may also include additional layers such as a root barrier and drainage and irrigation systems. (The use of "green" refers to the growing trend of environmentalism and does not refer to roofs which are merely colored green, as with green roof tiles or roof shingles.

Benefits:

• Good thermal performance, with very low thermal bridging (y values), 447utilizing air-based insulation material

• Excellent summer overheating protection, due to high thermal mass of boards

• Excellent acoustic insulation for both airborne and impact (rain) noise

• Full design and site support available

• Full systems parts from Green Steps

• Robust and easy system to install

Fig. Shows the Eco friendly green roofing system

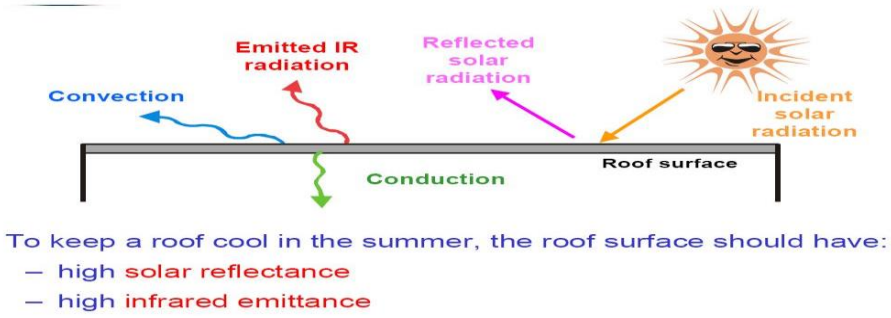

Fig . Working of green roof

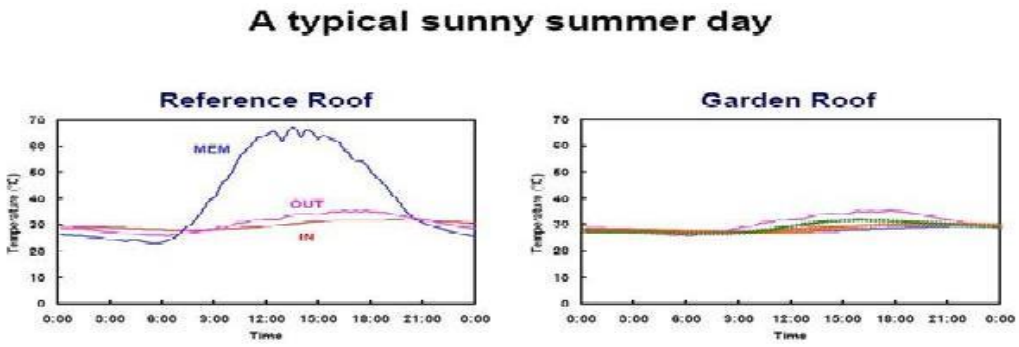

Fig. Shows the graphical representation of simple and green roof

CONCLUSION

From the above study done, it can be concluded that , all the non-renewable sources such as Fuels, Coals, Petroleum product etc., which are exhaustible or say nonrenewable will be definitely secured by adopting such sustainable concept of -Zero Energy Building . Also the global issues like pollution, global warming can be reduced due to lesser level. The maintenance

cost of the house is also reduced due to less consumption of energy, use of natural electricity from photovoltaic panel, more use of natural ventilation and lighting system. The Zero Energy Building strategy is eco-friendly and not harmful to nature. The material used in Building for construction can be efficiently reused for other work. Recycling of grey water and reuse of rain water results in lesser generation of the waste.

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