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Stepping Forward to an Evolution: Energy Efficiency Building Approach

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Abstract: ***Energy is one of the foremost vital catalysts in wealth generation, financial development, and social improvement in all nations. Buildings have an outstanding share of total energy consumed all-inclusive; in this manner, they have a significant effect upon the environment. Numerous developed countries have been driving the cutting edge within the energy-efficient buildings' advancement. Energy consumption leads to global warming, which may be an enormous challenge for the human race to preserve the climate appropriate for subsistence. Bangladesh is considered one of the foremost nations affected by climate change, as natural fiascos hit the nation more regularly. Saving energy by cost-effective energy-efficiency measures is the certain principal subjects for now. Contextual analysis is the starting step of the research. Through case studies, there are scoops to analyse the focal points and deficiencies of the pertinence in Bangladesh. A few convenient plan approaches can be taken to form energy proficient buildings. All through the writing overview prepare, the paperwork has some gaps; if extended haul scope of inquiring about within the areas of energy preservation in buildings is given, it can offer assistance to discover ways to make strides the quality of the human environment.***

Keywords: Energy, Global Warming, Contextual analysis, Human, Point, Building.

I. INTRODUCTION

A. Background

The condition of Energy Crisis and Environmental Impact is getting dangerous with the expansion of the world economy. The present economic system is alarming for our natural resources as well. Energy consumption leads to global warming which is a big challenge for the human race to maintain the climate suitable for subsistence. In recent years, primary energy consumption in the world constantly increased. Since the Second World War it rose to a current level, for 2013, estimated world energy consumption was 5.67 × 1020 joules, or 157,481 TWh. This trend was only interrupted by a slight decrease from 1979 to 1982, which was due to the second oil crisis. [1]

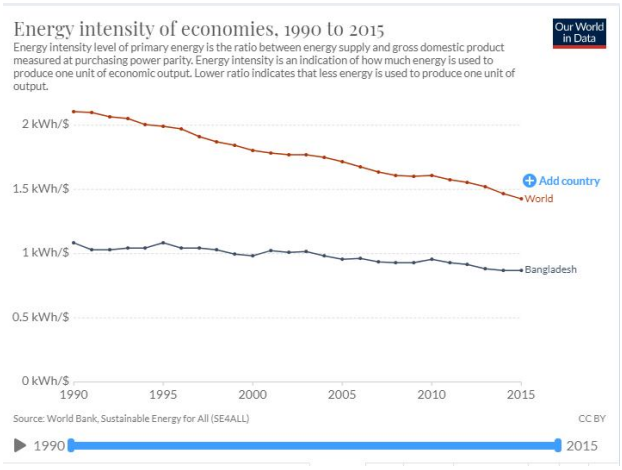

Figure 1:Energy intensity of economics

Source: World Bank

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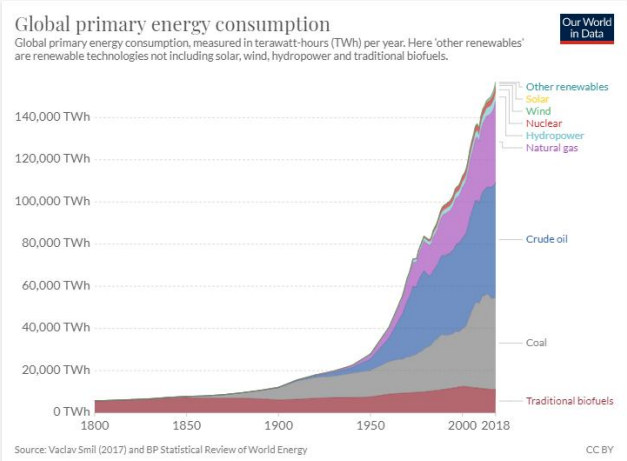

Figure 2 : Global primary energy consumption

Source: Statistical Review of World Energy

According to the IEA the total world energy consumption in past years was 143,851 TWh in 2008, 133,602 TWh in 2005, 117,687 TWh in 2000, and 102,569 TWh in 1990. [2] Therefore Many developed countries have been leading the forefront in the energy efficient buildings' development.

B. Condition of Bangladesh

Bangladesh is a country that is located in the heart of the Ganges-Brahmaputra-Delta in the south of the Asian continent [3] The country is considered one of the most countries impacted by climate changes along the year, as natural disasters hit the country more often.[3]Bangladesh is considered one of the fastest growing economies in the Southern-Asia, with 64% of the total population are living in rural areas [4]. Bangladesh positioned as ninth on the planet's biggest populated nations. The energy consumption per capita is an average of 332 kWh (5). Every day; more than 1500 people are turning from rural areas to urban areas. Figure 4 shows the energy balance of Bangladesh in 2012 with data mainly from International Energy Agency (IEA). Our primary energy supply is 33,172 ktoe, of which 55% is dependent on domestic natural gas, followed by 27% of biomass & waste in rural area and 15% of imported oil. On the demand side, out of 24,445 ktoe final consumption, the industrial sector uses 24% and residential sector (excluding biomass & waste) follows at 15%.

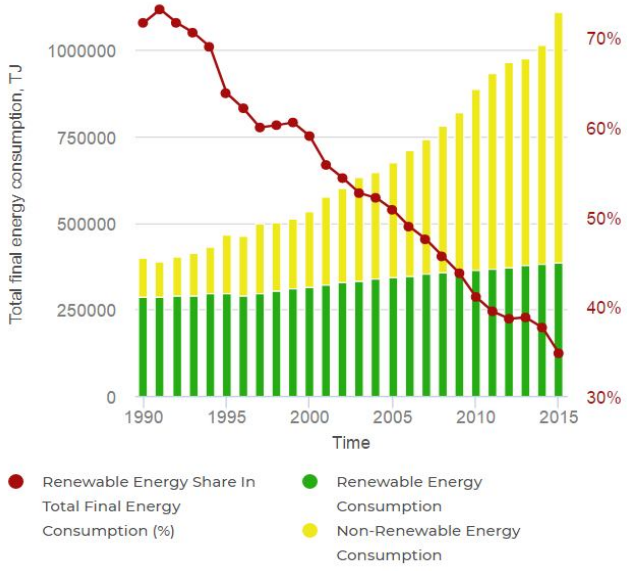

Figure 3 : Energy Situation

Source:https://energypedia.info/wiki/Bangladesh_Energy_Situation

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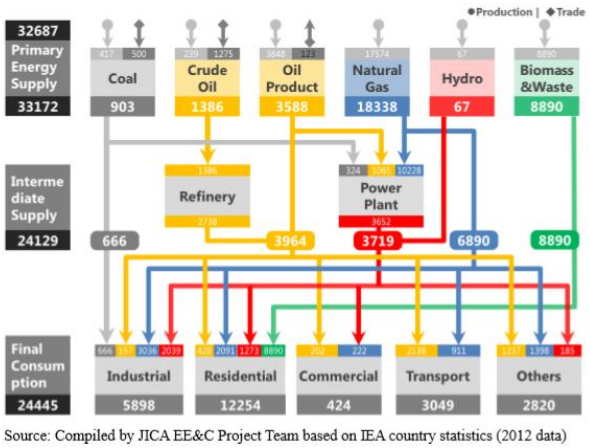

Source: Compiled by JICA EE&C Project Team based on IEA country statistics (2012 data)

Figure 4 : Energy Balance in Bangladesh

The latest sector-wise energy consumption (industrial, residential, transport, agriculture and commercial) is shownin Figure:5 industry has the biggest share at 47.8%, followedby residence and transport at 30.5% and 11.5%, respectively.

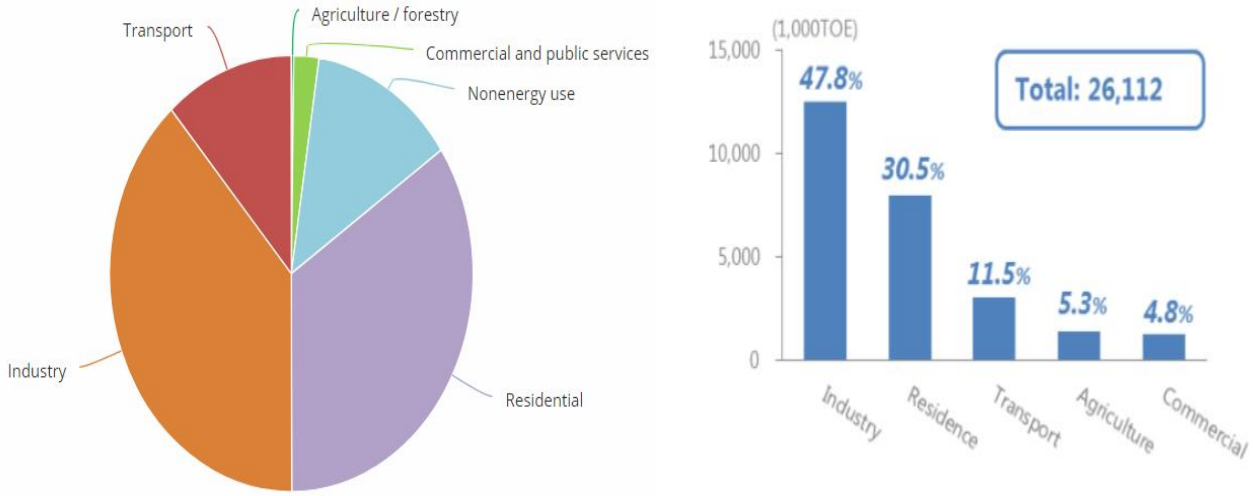

Figure 5 : Consumption in sectors

While transport sector is out of this EECMP's scope, by focusing on the industrial, residential and commercial sectors, we are able to cover more than 80% of the total energy use of this country.

C. Aim and Objectives

Saving energy is one of the most certain subjects for now. Modern buildings and facilities have considerable reserves to increase their thermal efficiency. If we employee current and emerging cost-effective energy-efficiency measures in new buildings and existing buildings as heating, cooling, lighting and other equipment systems are replaced, the growth in energy demand by the building sector could be reduced from the projected 30 per cent increase to zero between now and 2030. [s7]

1) Reducing energy consumption and the carbon footprint is one of the most essential goals for green buildings.
2) Constructing zero energy building (ZEB) or net energy (ZNE) building.
3) Effective residential zero energy buildings.
4) Reducing maintenance cost as well.
5) Lower emissions and overall environmental impact
6) Better thermal comfort
7) Interactive sustainable buildings for energy positivity in a block of buildings

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II. METHODOLOGY

Contextual analysis is the initial step of the research. Several cases of energy-efficient buildings have been developed in developed countries, as well as many methods and theories for energy efficiency. With the case study, there are scoops to analyze the advantages and shortcomings of the applicability in Bangladesh. The figure presents a comprehensive framework of the research.

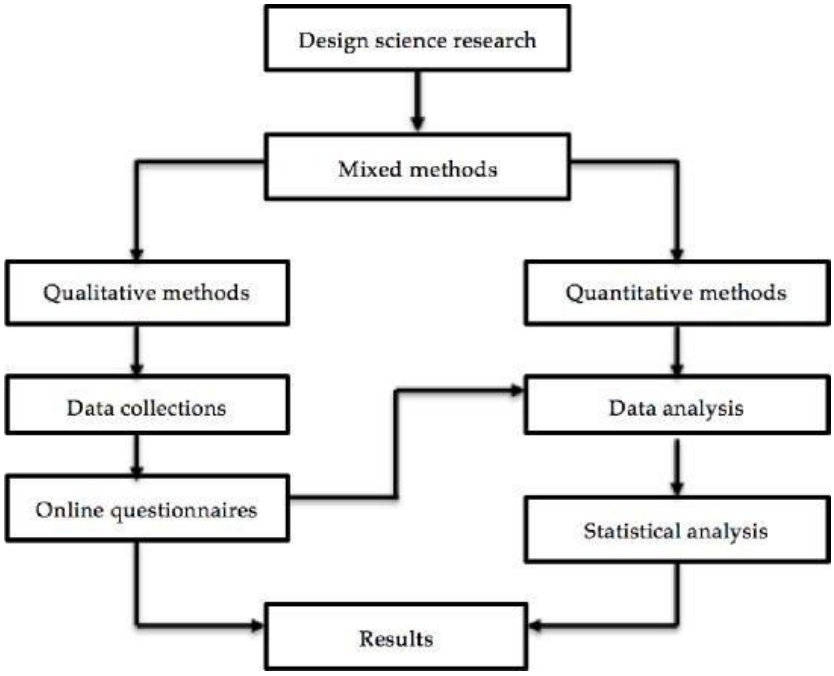

Figure 6 : General Framework

Conceptual framework of leading energy-efficient building planning and design stages is shown in Figure 1. The stage 1 (building site data analysis and limitations) of energy efficient building planning and design process. Detailed description of the first stage approach is presented in Figure 7

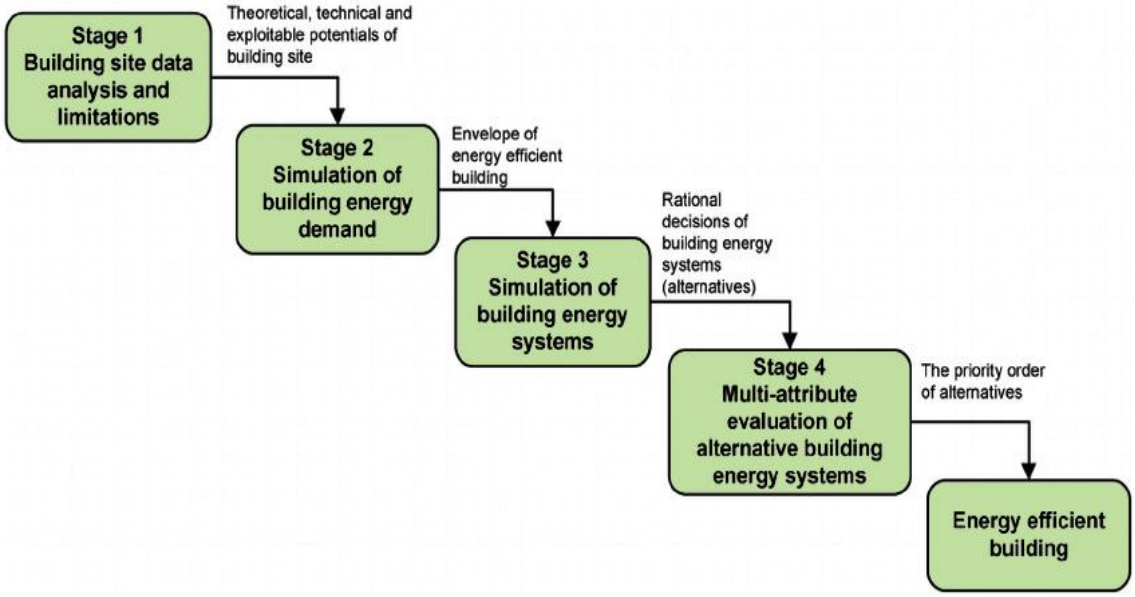

Figure 7 : Framework

Source: https://www.researchgate.net/figure/Conceptual-framework-of-main-energy-efficient-building-planning-and-design-stages_fig1_271195795

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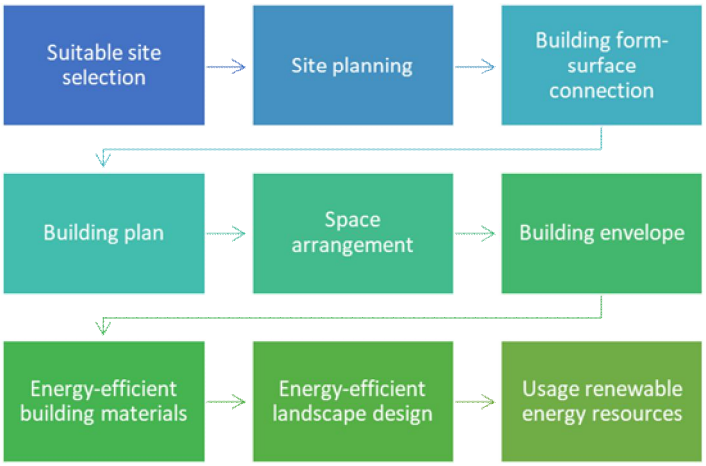
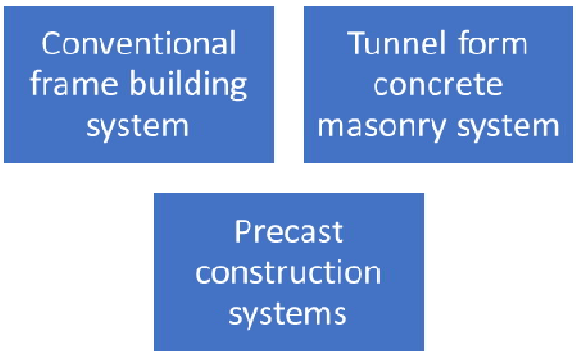
A. Energy-Efficient Designing Methods in the Prebuilding Phase



B. Energy-efficient designing methods in building phase (7)



(ref: Hozatlı B, Günerhan H, Life cycle assessment of buildings constructed with reinforced concrete and wood material in terms of Muğla province, Engineer and Machine, 2015;56(660):52–60. [67] Esin T, Çoşgun N, Betonarme Yapım Sistemlerinin Ekolojik Açıdan Değerlendirilmesi (Ecological Evaluation of Reinforced Concrete Construction Systems), 2. Ulusal Yapı Malzemesi Kongresi ve Sergisi 6–8 Ekim 2004, İstanbul.)

III. DESIGN APPROACH

Energy efficient buildings (new constructions or redesigned existing buildings) can be characterized as buildings that are planned to supply a noteworthy decrease of the vitality require for warming and cooling, freely of the vitality and of the types of gear that will be chosen to warm or cool the building. This can be accomplished by the following elements:

A. Bioclimatic Architecture
B. High Performing Building Envelope
C. High Performance Controlled Ventilation

Only when the building has been planned to limit the vitality misfortune, it makes sense to begin looking at the vitality source (counting renewable vitality) and at the warming and cooling supplies. We call this approach as the Trias Energetica concept. The Trias Energetica a model developed by the Delft University of Technology– acts as a guide when pursuing energy sustainability in the building sector.

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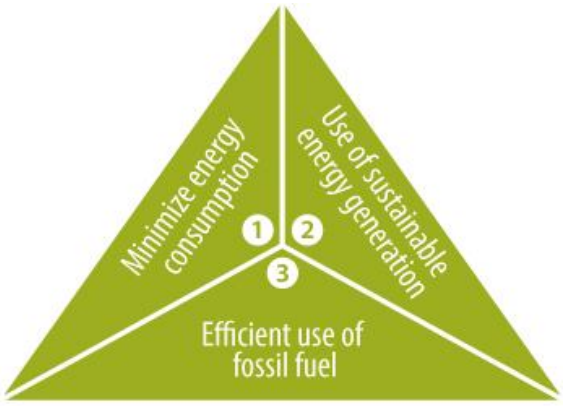


Figure 8: Trias Energetica concept

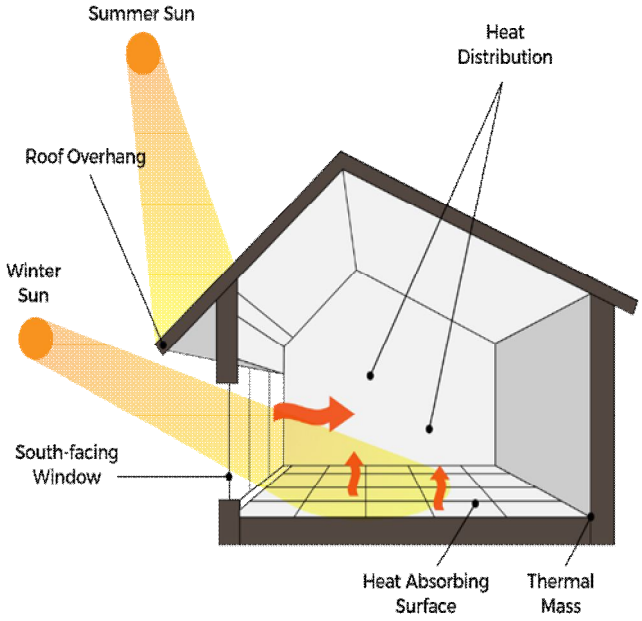
Source:https://www.vantilburgbv.nl/blogs/trias-energetica/

1) *Bioclimatic Architecture:* A feasible design approach in endeavor to put through with nature whereas keeping up building consolation based on local climate.

IV. STANDARDS OF BIOCLIMATIC DESIGN

A. Passive Solar Heat Protection

This framework is accomplished by utilizing the appropriate area and orientation of the building which in return would ensure it from overheating by the sun. Being molded more towards shading, its plan will be based on the direction of sun path as well as the nearness of surrounding trees or arranging highlights, at the same time centers on treating the uncovered façade by utilizing materials that assimilate critical sum of occurrence solar heat and radiation.



B. Passive Cooling Technique

As heat protection does not fundamentally ensure zero heat gain, a subordinate framework is embraced which works by disseminating heat collected within the building by natural means. Passive cooling consolidates different methods such as normal ventilation, night flush cooling, direct and indirect radiative cooling, evaporative cooling as well as soil coupling. For natural ventilation to function viably, fitting situation of openings is to be done based on the heading of wind.

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C. Natural Daylighting System

Daylighting system functions by setting openings or windows and reflective surfaces at appropriate areas of the building based on the sun path. This gives adequate diffused normal light and guarantees viable inner lighting amid the day whereas maintaining a strategic distance from the issue of glare. This framework maximizes visual consolation and permits diminished energy consumption as less manufactured lighting is used.

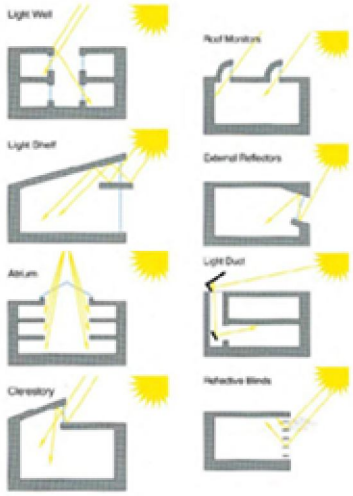

Figure 9 :Shading techniques

Source: 10-21-10: Shading devices and techniques

D. High Performing Building Envelope

This framework is accomplished by high performing glazing and windows, air-sealed construction, thorough insulation, avoidance of thermal bridges.

V. HIGH PERFORMING GLAZING AND WINDOWS

A. Double-Pane Glass

1) Holds warmer in the winter keeping home warmer whereas reducing energy costs
2) Reflects warm in the summer to decrease cooling costs
3) Saves texture, furniture and floor covers from blurring by blocking UV beams 90 percent more successfully than standard glass
4) Controls glare in shinning, sunny climates
5) Available in all window options
6) Best for utilize in: All Climates

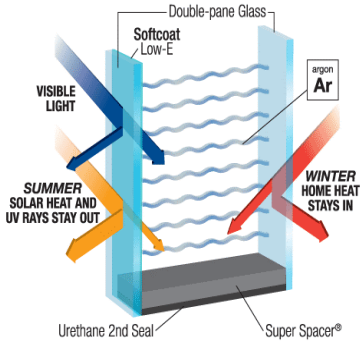

Figure 10: Double-Pane Glass

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B. Triple-Pane Glass

1) Holds the foremost warm in the winter keeping Home warmer while lessening energy costs
2) Reflects most heat in the summer to decrease cooling costs
3) Spares texture, furniture and floor covers from blurring by blocking UV beams 99 percent more effectively
4) Controls glare in shinning, sunny climates Most extreme noise control Gains the most noteworthy vitality proficiency rating from Vitality STAR®
5) Accessible in all window options
6) Best for utilize in: All Climates, particularly where extreme cold or extreme heat occur. Moreover perfect for greatest noise control.

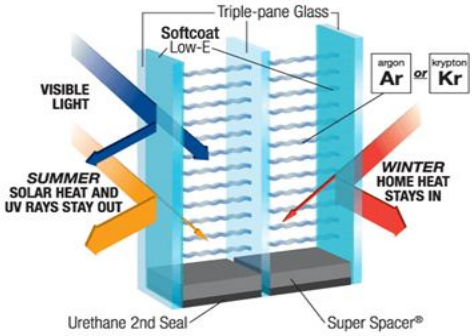


Figure 11: Triple-Pane Glass

VI. AIR-SEALED CONSTRUCTION

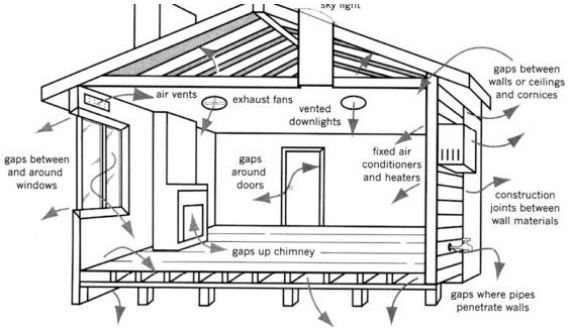
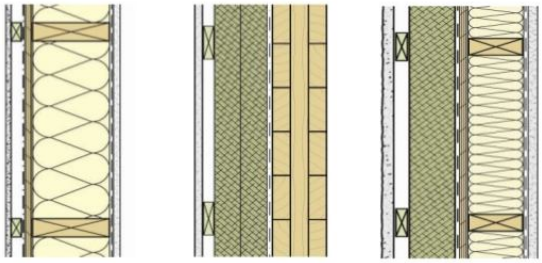


Figure 12:Air-Sealed Construction

Air sealing is basic to temperature and dampness control, and diminishes draftiness, noise and pollutants. It too plays an vital part in energy efficiency. Appropriate fixing of joints and penetrations in the building envelope can decrease vitality utilization for heating and cooling by 30%.

VII. THOROUGH INSULATION

Insulation helps decrease condensation, damp and mould. Insulation decreases the rate of heat loss through ceilings, walls and floors. It traps air in little pockets and gives an obstruction to halt heat from escaping.



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VIII. AVOIDANCE OF THERMAL BRIDGES

Thermal bridging is the movement of heat over an object that is more conductive than the materials around it. The conductive fabric makes a way of slightest resistance for heat. Thermal bridging can be a major source of energy loss in homes and buildings, leading to higher utility bills. With walls it is easier to avoid thermal bridges by utilizing timber frames with external insulation, such as wood fiber insulation, which can at that point be rendered or clad. Cavity brick work can moreover be utilized to avoid thermal bridges by utilizing full fill cavities of the suitable width and also the proper insulating lintels over the window and door openings. Most roof structures are made from timber which is inalienably insulating but the more complex the structure is the harder it gets to be to form it thermal bridge free. Once more, wood fiber insulation boards can be utilized over the rafters to anticipate thermal bridging and protected against summer sun.

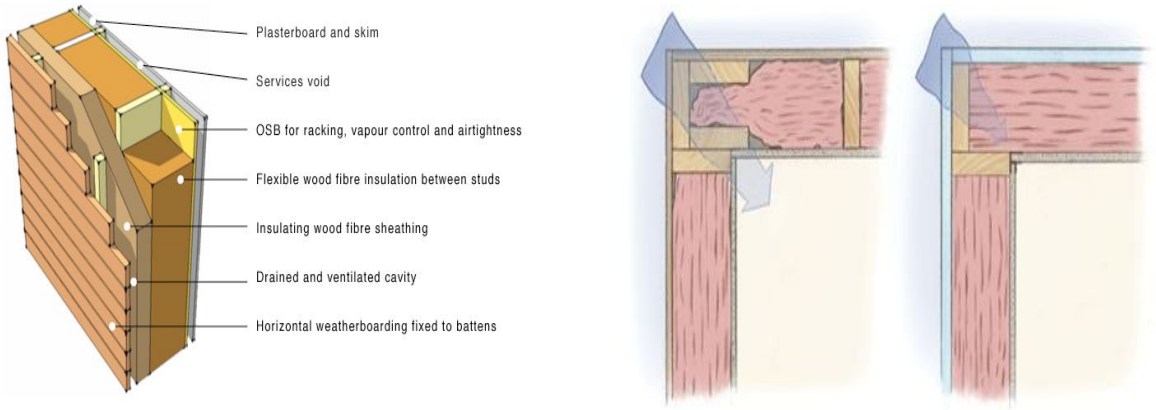
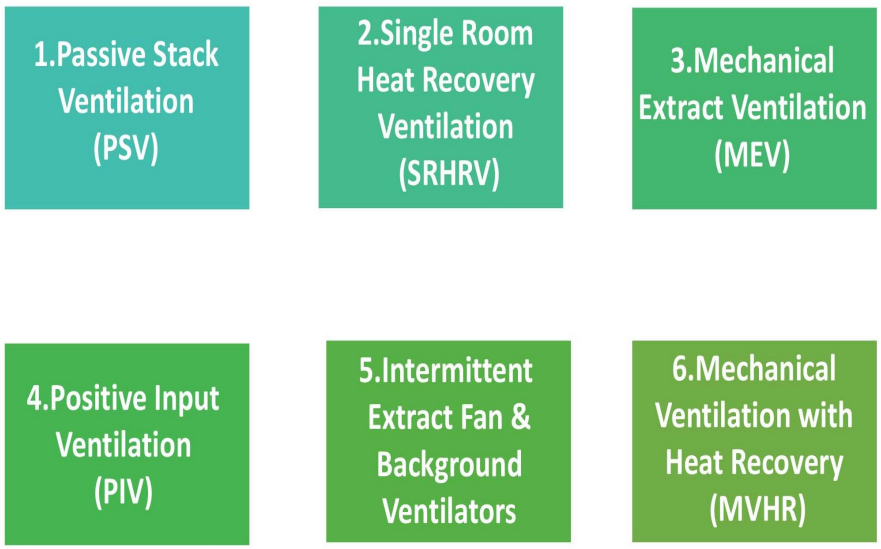


Figure 13: Wood Fibre Insulation

Wood is a thermal bridge; foam is a thermal barricade. Three-stud corners restrain the sum of cover put in a corner. The wooden bridge and air pockets carry cold air through the wall. A layer of foam breaks the bridge, and a two-stud corner makes room for insulation.

A. High Performance Controlled Ventilation

High performance-controlled ventilation can be achieved in many ways.



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IX. BENEFITS OF ENERGY EFFICIENT BUILDINGS IN DEVELOPING COUNTRY (BANGLADESH)

The proportion of buildings in national energy consumption is frequently higher in developed countries (U. S. 39 per cent, France 42 per cent) and lower in developing nations (Brazil 20 per cent, China25 per cent), which might occasionally result in ignoring the importance of the industry in these places [7]. Urbanization contributes to increased energy use in buildings, especially electricity, which becomes less challenging to get and the demand for energy services such as refrigeration, lighting, heating, and cooling-increases. Thus, by constructing energy efficient building, there are chances to consume less energy in developing country. And we promise to get

A. Healthier Indoor Environment Quality
B. Reduced Resource Consumption
C. Lessens costs for building occupants.
D. Lower Environmental Impact
E. Greater employee efficiency
F. New oil supplies and new power plant investment

X. FUTURE RESEARCH SCOPE

Throughout the literature survey process, the paperwork has some gaps; if the future scope of research in the fields of energy conservation in buildings is provided, unit model simulation, energy gain by modular unit, or construction can be simulated. In Climate Responsive Buildings, the further examination should be possible to plan detached cooling ideas, and In Climate Responsive Buildings, the further examination should be possible to plan detached cooling ideas, which can provide a higher degree of thermal comfort in a hot and humid climate and effectively remove the need for air conditioning. Sustainable buildings and structures include the study of the possibility of the use of clean renewable energy, the optimal use of the requested energy, water conservation, use of building materials reuse, improve the quality of the human environment. [8]

XI. CONCLUSION

Energy-efficient buildings are introduced to deal with the environmental problem. Energy-efficient buildings reduce the consumption of energy over its existence in numerous ways. Comfort and energy preservation are two features to describe building characters. It is essential to examine the complex development and the environment, steadily presented new innovations, continually moving toward the fundamental objective is a practical improvement as design as like the entire Country. As mentioned before, Bangladesh is a developing country, for Sustainable development needs to think systematically. Vitality utilization in structures happens in each period of building life cycle. Again, buildings have a huge potential for energy efficiency which is why necessary steps should be taken to improve the efficiency in buildings. Developing a building is not an easy job. More specialists include more experts in the construction industry, such as architects, developers, builders, contractors, installers to bring the diverseness of socio-economic factors like culture, tradition and ethnicity.

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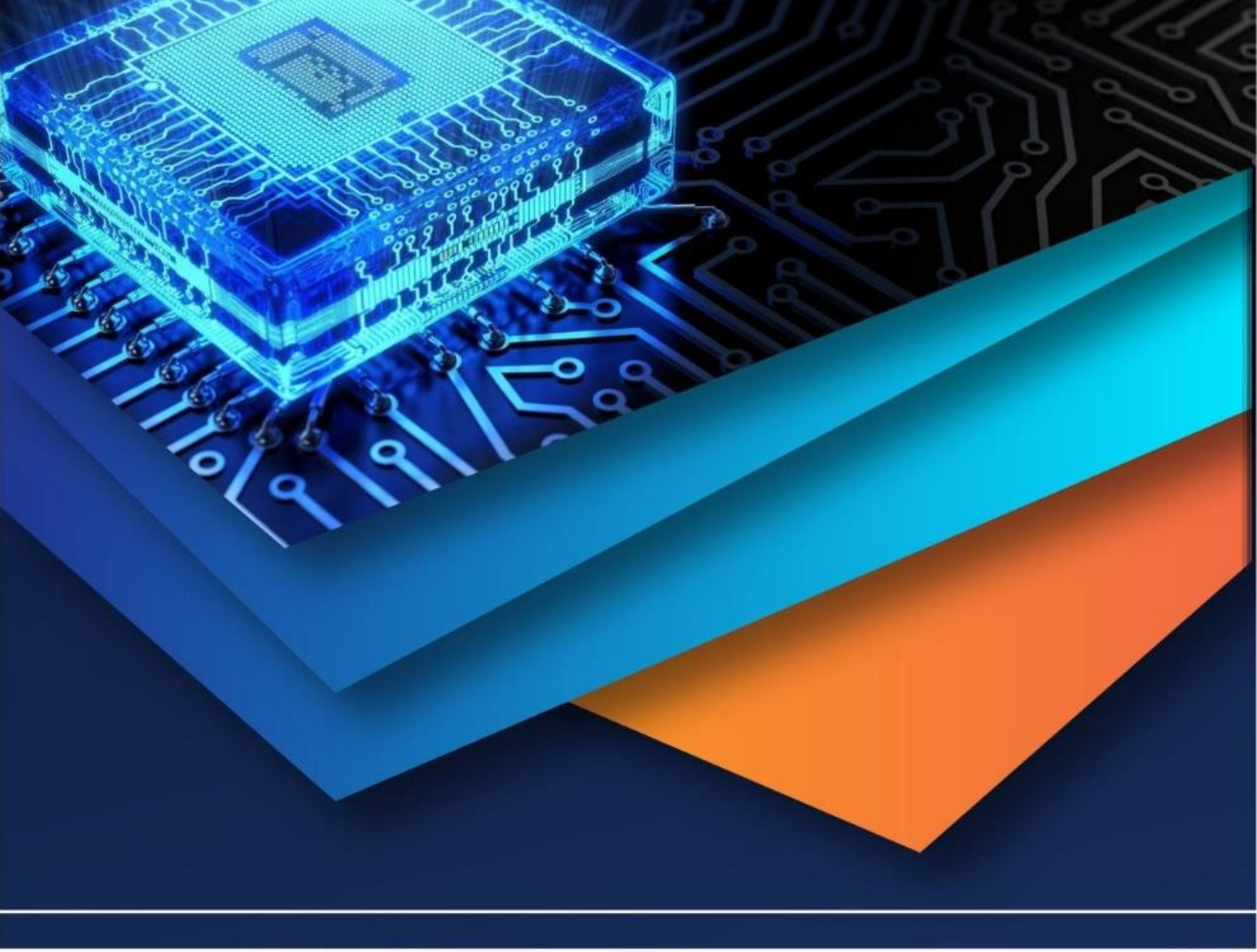

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