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# Introduction of Biomimicry into Construction of Budget Houses

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**ABSTRACT**

In this project, we are aiming to put forward an efficient plan introducing elements of biomimicry into the construction of budget houses with alternative materials other than conventionally used materials. The materials used are V Boards, Aerocon Panels, Structural Steel and Fabrication steels. Concrete slabs using corrugated sheets are also used as an alternative. Moreover, as a biomimicry element, concept of air cooling from termite moulds are introduced. Also, funicular concrete roofing is done which is another biomimicry element. Honeycomb skylights are also used as an element of aesthetics. Comparison between a conventionally built house and house built alternatively by our concept is done to prove house built by our concept is more cost-efficient and energy efficient.

**Keywords: -** Alternative, Biomimicry, Budget Houses, Cost effective, Energy Efficient, Sustainable.

## 1. INTRODUCTION

India is a developing country, still many of the people are unable to fulfil their dream of having a house. So, it is necessary to introduce a home with better aesthetics and away from the conventional concepts of design. In this paper we will be introducing alternate materials instead of conventional materials to minimize the cost. Also, with some biomimicry elements to provide a better environment inside the house, we are trying to resolute the problem of increased temperature inside the rooms. Since many researchers had proven to show that air pollution inside the house is much greater than outside making it a major cause of death of 3.8 million people annually. So, we need to put into account the problem of air pollution inside the house.

## 2. ALTERNATE MATERIALS

### 2.1 V BOARDS

For interior partitions, we will be using V-board which is shown in *Figure 1*. V boards are commonly used materials in construction. V boards are made from gypsum plasterboard that has been reinforced with glass fibers. We have selected V boards as it is one of the most economic construction materials. Also, they are light weight, easy to install, fire resistant and provides good sound insulation. In our project, V boards of 8 mm thickness are used.

*figure 1: v board*

### 2.2 AEROCON PANELS

Aerocon panels are used as exterior walls and as walls of bathroom since these parts may get in contact with water. Aerocon panels are type of building material that are commonly used in construction projects. These are made of mixture of cement, fly ash and expanded polystyrene beads which makes them lightweight, strong and durable. By using Aerocon panels for the exterior part of the house, there are several benefits like excellent

insulation properties, moisture resistant, fire resistant and pest resistant. Also, it helps to improve energy efficiency, durability and overall aesthetics.

*figure 2: aerocon panels*

2.3 DECKING SHEETS

Decking sheets *(Fig. 3)* can be used as a floor slab in construction, particularly in situations where a lightweight and cost-effective flooring solution is required. Decking sheets are typically made of steel and come in a variety of sizes, thicknesses, and profiles.

When used as a floor slab, the decking sheets are laid perpendicular to the supporting beams or columns and are then covered with a layer of concrete with mild reinforcement. The concrete acts as a reinforcement for the decking sheets, creating a composite floor system that is strong and durable.

One of the main advantages of using decking sheets as a floor slab is that they are lightweight and easy to install. This means that construction times can be reduced, which can result in cost savings. Additionally, decking sheets are often prefabricated, which means they can be made to specific sizes and profiles, further reducing construction time and costs.

Another advantage of using decking sheets is that they provide a smooth surface for finishing. This makes them ideal for use in areas where a high-quality finish is required, such as in commercial buildings, hospitals, and hotels.

Overall, decking sheets can be an effective and cost-efficient solution for flooring in many construction projects, but it is important to carefully consider the specific requirements of the project before deciding to use them.

*figure 3: decking sheets*

## 3.BIOMIMICRY ELEMENTS

3.1 HONEYCOMB SKYLIGHTS

Honeycomb skylights are an example of how biomimicry can be used in house design. Honeycomb structures are found in many natural systems, including beehives, and are known for their strength, light weight, and efficient use of materials.

When used as skylights in a house, honeycomb structures can provide natural light while also reducing energy costs. The hexagonal shape of the honeycomb allows for a larger surface area compared to circular skylights, allowing lighter to enter the space. Additionally, the air pockets within the honeycomb structure provide insulation, which can help regulate the temperature within the house and reduce the need for artificial heating and cooling.

Furthermore, honeycomb skylights will allow more sunlight to enter which will reduce the germs inside the house, which in turn improves the air quality of the house.

Overall, incorporating honeycomb skylights as a biomimicry element in house design can provide a sustainable and energy-efficient solution for lighting and climate control. Most importantly these provide a better aesthetic appearance like that in *Fig.4.*

*figure 4: honeycomb skylights*

This can help reduce energy consumption and lower utility bills, while also providing a healthier and more comfortable living environment for occupants.

Overall, the termite mound ventilation system is an excellent example of how biomimicry can be used to create sustainable and innovative solutions for the built environment.

### 3.2 TERMITE MOUND VENTILATION

One of the key features of termite mounds is their ventilation system, which helps regulate temperature and humidity levels inside the mound.

This ventilation system can be considered as a biomimicry element that can be applied to buildings and houses to improve indoor air quality and reduce energy consumption. By designing a building with a ventilation system inspired by the termite mound, we can create a more sustainable and comfortable living space.

The termite mound ventilation system works by using a network of interconnected tunnels and air pockets that allow air to circulate freely. This helps regulate temperature and humidity levels inside the mound, preventing the growth of harmful mold and bacteria.

*figure 5: termite mound ventilation*

In a similar way, a building designed with a termite-inspired ventilation system can use natural airflows to regulate indoor air quality and reduce the need for mechanical heating and cooling systems like in *Figure 5*.

### 3.3 FUNICULAR CONCRETE ROOFING

Funicular roofing, which got inspired from the shape of an eggshell. Such structures are designed to follow the shape of funicular curves like shown in *Fig. 6.*

Funicular structures can be found in a variety of forms, including bridges, towers, and even buildings. They are characterized by their graceful curves and efficient use of materials, which allows them to support large loads with minimal use of structural elements. They are often used in situations where there are large spans or significant height differences. Their unique shape allows them to distribute loads evenly, making them both strong and aesthetically pleasing.

In our case, we can use this design to eliminate the use of traditional reinforcement and minimize the use of construction materials without compromising the required strength and other properties.

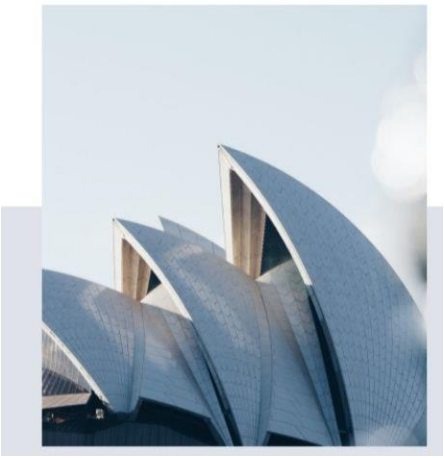

*figure 6: funicular shape*

## 4.INSTALLATIONS

### 4.1 FOUNDATION

The usual kind of foundation found in construction of normal houses is Random Rubble (RR) masonry. Large stones, irregular in size and shape are stacked in order to form a foundation structure. As we peek into the current ecological and economical situations, we could see mining of stone affects the environment negatively as it contributes to climate change, loss of bio diversities, avalanches, and the beauty of nature. Even if available,

They will be of very high price and require skilled labors for the construction. Thus, we find that it is not feasible to conclude using RR masonry as the foundation.

So, to tackle this problem, we can change the foundation to normal isolated footing where the column from the foundation reaches to the plinth level. At the top of the column, there will be a channel to hold the plinth beams. The details about the plinth beams are elaborated in 4.2.1.

So, in this way, the use of stone and related aggregates can be minimized a lot, reducing the overall cost. At some points, where isolated footing is not possible, it is ideal to use combined footings.

4.2 SUPPORTING STRUCTURES

4.2.1 PLINTH BEAM

Usually, it is concrete beams which are developed as plinth beams in construction of houses. As we are having an aim to reduce the amount of concrete in construction as its components are getting costly and are not ecologically sustainable, we are proposing to change the plinth beams to I-Section steel bars.

Another advantage of using steel I-section beams over concrete plinth beams is that the steel beams are more resistant to bending and deflection than concrete beams. This means that they can support heavier loads and span longer distances without the need for additional support or columns.

4.2.2 COLUMNS AND BEAMS

The columns and beams we had proposed to give are steel I sections. The time that will take for the construction will be less compared to normal construction. Steel columns offer several advantages over concrete columns in terms of strength, durability, flexibility, speed of construction, fire resistance, and sustainability.

Since the total weight of our project on earth is much less compared to the normal conventional houses. The dimensions of columns and beams can also be minimized thereby its weight without compromising its strength.

Steel columns have a greater flexibility so that we can create the pattern we desire easily and quickly.

Steel columns are naturally fire-resistant and can withstand high temperatures without losing their structural integrity. This makes them a safer choice for buildings that require fire protection.

Steel structures can be designed to be seismic resistant. Steel is a strong and ductile material that can withstand seismic forces better than many other materials. Additionally, the flexibility and ductility of steel allow it to deform and absorb energy during a seismic event, reducing the forces that are transmitted to the rest of the building.

4.2.3 FLOOR SLAB

The floor slab is created by laying down a series of decking sheets, which are typically made of steel, and then pouring concrete on top of them.

First the supporting structure, which may consist of beams or columns, must be designed and constructed to meet the requirements of the decking system. The surface of the supporting structure must be cleaned and made free of debris before installation.

After that the decking sheets are laid out onto the supporting structure in the required pattern and orientation. The sheets are typically overlapped and fastened together using screws or other fasteners to ensure a secure fit. Once the decking sheets are in place, they are welded to the supporting structure using electric welding. The welding process helps to ensure a strong connection between the decking sheets and the supporting structure. After the decking sheets are securely attached to the supporting structure, concrete is poured onto the sheets and is levelled and spread out evenly. Then for a specific period it is allowed to cure. After curing the surface of the slab is finished to achieve the desired appearance and texture. The finish may include polishing, painting, or applying a coating.

*figure 7: floor slab*

## 5.PLAN

The AutoCAD drawing in the figure 8 depicts the detailed plan of our house including its layout, dimensions of each room, including wall height, door and window placement. This plan shows a one-story house with a sit out, living room, dining area, kitchen, work area, three bathrooms and three bedrooms. The square ft of our house is 1352.26. We have assumed a rectangular plot of size 20 cents.


*figure 8: plan*

## 6. OTHER ADVANTAGES

Since the house we designed has space open under the floor slab, if there is a case of flooding, the water can freely pass below up to the plinth level. This cancels the chance of having thrust on any parts of the house.

## 7.CONCLUSION

Low-cost construction materials like V board panels, Corrugated sheets and Aerocon Panels are some of the most suitable alternative materials of low cost that can be used for constructing houses. There is a need to build houses of low cost which ensure providing shelter for every needy one in our country. This need can be rectified to some extent by using these methodologies of low-cost construction. Also, Introduction of biomimicry in housing projects can reduce hazards to the environment. By biomimicry what we mean is that we are trying to include the idea of temperature reduction inside the house by passive methods other than conventional active ones. Natural and atmosphere friendly designs can also bring aesthetic appearance to the building. By implementing these ideas, a new environment friendly and low-cost house can be constructed, which may be affordable by everyone who is in a need of shelter

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