

# An Experimental Study on Rotating House Based On Heliotropism

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**Abstract** – The natural and non-renewable resources are depleting at a fast rate. It is essential to use other forms of resources such as wind, solar, which is abundantly available. The time is high to start developing passive houses, because the conventional houses are consuming 40% of the world’s efficiency. In order to overcome the situation, India has introduced smart city concept which will result in saving up of energy. The project follows passive housing design and incorporates the mechanism of sunflower known as heliotropism i.e. the building rotates on the path of sun to an angle of 15-25° in East and West direction. This is done in order to capture the full potential of sun’s energy and transform it into electrical energy which will energize the building. Passive houses will help in ultra-low energy usage because of its orientation, which will help in ventilation and air circulation. The building is designed with green building materials to increase the living conditions and reduce the weight to help in easy rotation. The house also helps in life long cost efficiency, since it saves cost on construction and energy.

## I.INTRODUCTION

**Sustainable Buildings** are those which aims to minimize the environmental impact of a building and its associated grounds as it provides a safe and comfortable living. Conventional building practice does not work within the boundaries of this strategy. Too often our buildings make us sick due to poor indoor air quality, waste our precious energy, and cost more to maintain and operate than what can be achieved.

## II.HELIOTROPISM

In plants, heliotropism refers to directional growth of plant in response to sunlight. In general, the natural movement of any organism facing the path of the sunlight is known as heliotropism. Buildings can follow this from of tropism by the combined usage of sensors and electric motors

When buildings incorporate the concept of heliotropism, a huge amount of conventional energy can be conserved. The solar energy can be used water heating, HVAC and cooking systems.

## III.PASSIVE HOUSE DESIGN

The use of natural movement of heat and air to maintain comfortable temperatures, operating with

little or no mechanical assistance. The design follows 5 main principles of design

- Orientation
- Sunshades
- Insulation
- Windows
- Thermal Mass

### A.Orientation of house

The way a building is situated on a site and its positioning of windows, rooflines and other features is known as **Building Orientation**. A building oriented for solar design takes advantages of passive and active solar strategies. Passive solar strategies use energy from the sun to heat and illuminate buildings. The best suited orientation for the house is North- South direction. This will allow more sunlight in the house. Good orientation can increase the energy efficiency of our houses, making it more comfortable to live in and cheaper to run.

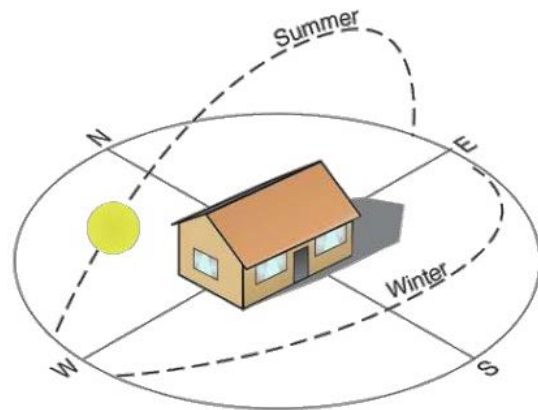


Fig 1 Best Orientation for house

### B. Plan of the house

The orientation of the house is North- South for maximizing the energy efficiency. The windows are placed more in the east and west direction to allow more sunlight inside the house. Since the sun’s rays have the full capacity between North-West and North-East, the placing of windows are proper here.



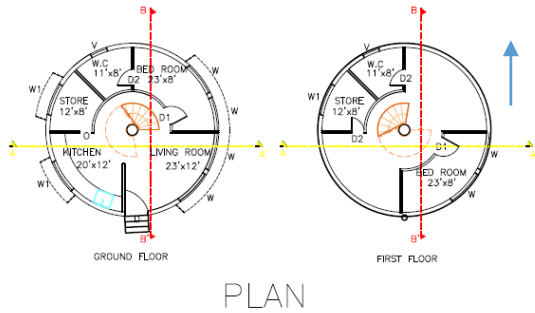


Fig 2 Plan of the house

#### IV. FRICTION DAMPERS

A friction damper is a device used for controlling and damping spring oscillations. It is also called as shock absorber. It helps in smooth movement of the building during earthquakes. Similar mechanism can be used while rotation of the building too.



Fig 3 Friction Damper Setup

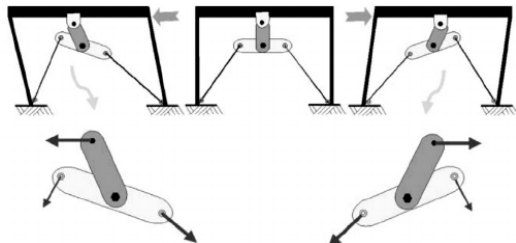


Fig 4 Mechanism of Friction Damper

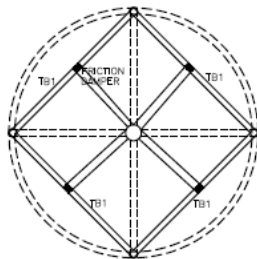


Fig 5 Positioning of Friction Damper

#### V. ROTATION MECHANISM

The electrical power generation from Heliotrope building consists of the following components to full fill the requirements of complete operations of a machine.

- Building

- Worm gear
- Control unit
- LDR sensor
- Limit Switch

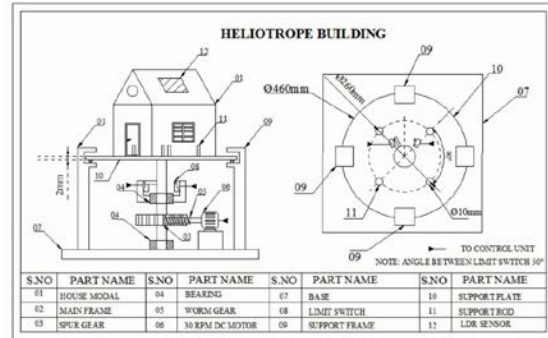


Fig 6 Drawing for Heliotrope Mechanism

#### A. Thrust Ball Bearing Calculations

To find minimum axial load for thrust bearing

$$F_{am} = A(n/1000)^2$$

$$\begin{aligned} \text{Total weight of building + Mechanical Setup is upto} &= 78 + 10 \\ &= 88 \text{ tonnes} \end{aligned}$$

Considering factor of safety half of the actual weight of building and setup

$$= 88 + 44$$

$$= 132 \text{ tonnes}$$

The weight is shared by 5 points during rotation of building

$$130 \text{ tonnes} / 5 = 32.5 \text{ tonnes/point}$$

$$\begin{aligned} F_{am} &= A(n/1000)^2 \\ &= 8 \times 10^9 (5/1000)^2 \end{aligned}$$

$$F_{am} = 200000 \text{ N}$$

The minimum axial load for each point is much greater than the calculated value. Hence our bearing design is safe.

#### VI. BUILDING MATERIALS

The heliotrope building uses eco-friendly and green building materials for its construction. The main purpose of the building is to provide a comfortable living and also an energy saving one. The materials used should satisfy the following selection criteria:

- Resource Efficiency
- Indoor Air Quality
- Energy Efficiency
- Water Conservation
- Affordability

### A. Autoclaved Aerated Concrete Blocks

The AAC Blocks are the popular building material now used widely in replacement with clay bricks. They are made with fly ash, cement, lime and an aerated agent. It possess the following properties:

- Light weight
- High Strength
- High thermal insulation
- High sound insulation
- Dimensionally Accurate

### B. Testing of AAC Blocks

- 1) Compressive Strength Test
- 2) Water Absorption Test

The specimens are tested according to IS 2185(Part III) mentioned procedures.

TABLE 1 COMPARISON OF PROPERTIES

S.NO	FEATURES	AAC BLOCKS	CLAY BRICKS
1	Density	550kg/cum	1800kg/cum
2	Thermal Insulation	Very good	Average
3	Noise Insulation	Very Good	Average
4	Compressive Strength	3 Mpa	Quality can vary
5	Environmental Impact	Ultra Positive	Very Negative
6	Usability	Easy to cut and handle	Low strength – Easy to break High Strength- Difficult to cut, easy to handle and time consuming
7	Availability	Availability Increasing	Availability decreasing in urban areas
8	Efflorescence	Absent	Generally present
9	Structural Savings	Less reinforcement requirement	High reinforcement requirement
10	Consumption of Cement Mortar	0.77 bags of cement/cum	1.44 bags of cement/cum
11	Thermal Conductivity	0.12w/m-k	0.8w/m-k
12	Energy Saving	Approx 30% for heating and cooling	None
13	Cost benefits	Reduction in dead weight leading to savings in steel and concrete	None
14	CO <sub>2</sub> Emission	One sqft carpet area – 1.5kg	One sqft carpet area – 12.0kg

### VII. ENERGY CONSUMPTION

We need different sources of energy to run a home. Electricity plays a main role in balancing and maintaining the needs of house and living conditions. Conservation of electricity results in economical running of the house and saves money. The following table says about the cost of usage of current with and without heliotropism.

TABLE 2 COST ACCORDING TO TANGEDCO

	Conventional Usage	Reduced Usage
Consumed Units	550.5 kWh	360.8 kWh
Total Current	Rs.2413.3	Rs.1439.68

Charges		
New Subsidy	Rs.350	Rs.727.68
Net Amount	Rs.2113.3	Rs.712.00

### A. Solar Panel Installations

Cost for setting up Solar Panel = Rs.60,000

Lifetime of Solar Panels = 25 years

Misc Expenses = Rs.2000/yr

For 25 years, the expenditure is Rs.50000.

### B. Return on Investments

TABLE 3 COST COMPARISON

Type of usage	Per year	For 25 years
Conventional	12,700	3,17,500
Reduced	4,300	1,07,500

Total Savings = Rs.2,10,000

Deducting Initial Investments = Rs.1,00,000

Thus, we can save upto Rs.1,00,000 by taking up heliotropism in a house.

### VIII. COST ESTIMATION

Cost of construction = 3,50,000

Cost of Surkhi = 23,000

Cost of Plumbing (LS) = 85,000

Cost of Electrical Works = 70,000

Total Cost of Construction = 5,28,000

For base and rotating mechanism,

Motor (20HP) = 1,00,000

Micro Processor Unit = 20,000

Wiring = 10,000

Base Concrete with reinforcement = 1,50,000

Hydraulic Lifting Arrangement = 1,50,000

Total Cost for the Building = 9,58,000

~ Rs.10,00,000

**The cost for construction of the house with rotation setup will cost about Rs.10,00,000.**

## CONCLUSION

The building gives its high efficiency when it is placed in North- South Orientation. Sunlight falls through the windows and openings and provide the sufficient light inside house during daytime which helps in healthy living. The materials used for the house are high in thermal insulating property. They help in reducing the heat from entering the house but allow light. They also help in reduction of overall cost of the building. The materials used are green and do not emit any harmful chemicals. The building being heliotropic, absorbs more sunlight through the panels installed and help in energizing the house resulting in saving of the electricity cost of the house and helps in conservation of fossil fuels and renewable resources. Since the materials used save the overall cost of the building construction, they can be utilized for other purposes of the house such as the rotation mechanism setup, plumbing and electrical works, installation of solar panels and miscellaneous activities.

## RECOMMENDATIONS

1. Plumbing work possess a great challenge in the house due to the rotation.
2. Water conservation activities can be extended in the future to make the house more energy efficient.
3. If this houses are implemented all over the state and country, it will lead to a huge saving in electricity and conservation of natural resources , thus making a comfortable way of living for the upcoming generations.

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