

Study of Earthship and its Principles

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Abstract—The earth ship is type of house that is made of recycled materials. They are constructed to use available natural resources. In this paper, six earth ship principles are studied and their application is explained in brief. Benefits of the earth ship like, it is energy efficient and self-sufficient to produce its own energy has also been discussed. Survey is also conducted to understand people's awareness about the earth ship principles.

Index Terms—Study of earthships and natural resources.

I. INTRODUCTION

The concept of Earth ship is introduced by architect Michael Reynolds in 1970s. Earth ship is a type of passive solar houses that is made of both natural and recycled materials. The earth ship is constructed to use available natural resources, especially energy from the sun and rain water. Architect Michael Reynolds wanted to construct houses with three things: first, material must be found locally or recycled materials; second, minimal reliance on public utilities and intended to off the grid ready homes; third, low energy used during transformation. The earth ship is an exemplar of eco-friendly living with low impact on the nature.



Fig. 1. Typical view of an earth ship

The aim of this paper is to study the earth ship principles in existing construction method. Earth ship principles are important because most of the world population live in urban areas where various activities, account to greenhouse emission which results in global warming. Hence, an earth ship principle uses natural resources i.e. energy from sun and rainwater.

II. SIX PRINCIPLES OF EARTH SHIP OR HUMAN NEEDS

A. Thermo-solar heating and cooling

The earth ship structures are made of rammed tires filled with earth. The walls of the structure are thick which trap sun rays.

This structure uses south facing windows which allow maximum sunlight to enter into indoor environment. So during the day, maximum heat is trapped by the walls and at night when temperature drops, the heat absorbs and stored in mass releases and makes comfortable temperature.

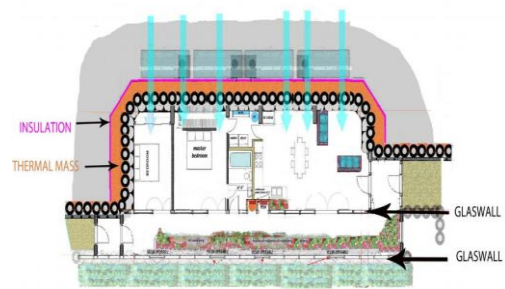


Fig. 2. Earth ship thermal wall construction

B. Solar and wind energy

The earth ship generates its own electricity from sun and wind. The solar panels are placed on the roof of earth ship so that maximum energy is capture. Electrical energy from photovoltaic panels and wind turbines are converted into DC current. DC electricity is stored into batteries. Earth ship is also designed with Power Organizing Module which takes some portion of stored energy from batteries and converts it for AC use. This module is prefabricated which includes circuit breaker and converter which is placed on interior walls of earth ship. This power module can be used for running kitchen appliances, television unit, computers, washing machines etc. These solar panels also heat the water which is stored in tank. The solar panel heaters are placed at the south side so that maximum sun rays are captured and water can be heated. Also small heater with batteries or electric backup is connected for cloudy days.

C. Water harvesting system

The roofs of an earth ship are designed to catch maximum rainwater. The sloped roofs which are made of non-harmful materials are used to collect the rain water. A cistern water catching system is provided where all the water from the roof gets collected and stored. The cistern has small pores from where water enters and a lid is provided to cover water from getting polluted. The cistern is located where the water can easily flow through gravity to the tank. The water from the cistern is further pump to filters which filter the water for drinking and other purpose.



Fig. 3. The earth ship with Solar Panels



Fig. 4. Sloping roof of an earth ship



Fig. 5. Cistern with small pores and lid

D. Self-contained sewage treatment

Earth ship self-sewage system is divided into two parts:

1. Grey water:

Water Management

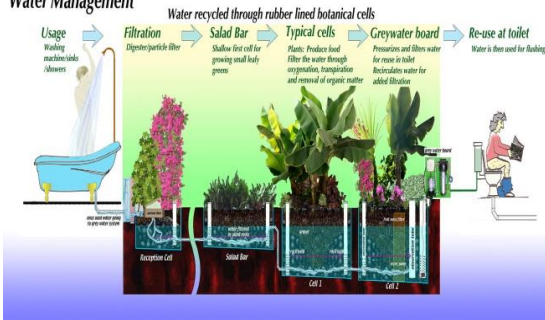


Fig. 6. Grey water management system

The grey water is clean waste from kitchen, basin, baths, shower etc. In earth ship this waste water is recycled and used for flushing toilets. This water is treated indoor in earth ship through botanical cell. In botanical cell the water is passed through filters in the form of plants. The water gets cleaned as it sinks down through the soil. The water at the bottom passes from the pipes to the toilets for flushing purposes.

2. Black water: the black water is water from toilets. The black water is a mixture of urines, excreta and flush water. In earth ship there is a septic tank which separates the solid waste from the water. This septic tank is located outside the earth ship. This septic tank contains plants which separate the solid waste from the water. The plants grown here are non-edible plants, as this plants uses contaminated water for growing. Also the septic tank is heated through solar for anaerobic digestion of waste.

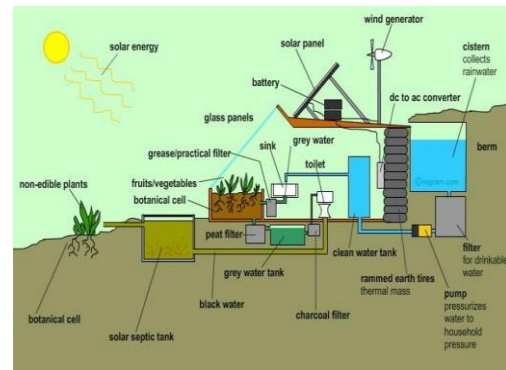


Fig. 7. Black water management system

E. Building with natural and recycled materials

1) Tyres



Fig. 8. Tyre wall construction

The earth ship is built with rammed tyres filled with earth (soil). This rammed tires wall act as thermal mass property which traps heat. Tires balls are also made by compressing tires in cubical form with huge hydraulic pressure. These tires are used because they are locally available, durable and low skills are required to build it.



Fig. 9. Tyre balls

2) Cans and glass bottle

The interior of the earth ship are constructed with cans and glass bottle filled mortar. These tin cans are also used to make strong walls of an earth ship. The glass bottles used in interior of an earth ship creates an aesthetic colored wall that shines.



Fig. 10. Waste cans and bottles wall construction



Fig. 11. Interior of earth ship with waste glass bottles

6) Internal food production capability



Fig. 12. Food grown inside earth ship

The earth ship is designed in such a manner that it can produce its own food. The plants grown inside the earth ship uses grey water for growing. The grey water is filtered and recycled by the plants

III. BENEFITS OF THE EARTH SHIP

1. Earth ship is energy efficient.
2. Earth ship provide large amount of thermal mass structure.
3. Reuse of waste materials such as used tires, tin cans, beer bottle.
4. The thermal mass of earth ship keeps the house cool in summer and warm in winter which saves the electricity.
5. This earth ship uses natural resources such as heat from sun and rainwater.
6. Self-sufficient to produce its own food and energy.
7. Self-contained sewage system for waste management.
8. Easy to build. No special skills are required.

IV. SURVEY

A questionnaire was prepared to conduct the survey. The question related to earth ship, use of recycled material and off the grid ready house was asked to different people. The data was collected and found that most of the people were interested to implement and follow earth ship principles but don't have proper information to proceed.

V. CONCLUSION

Earth ship is a concept which uses natural resources and do not depend on fossil fuels. Earth ship is constructed trough tyres and waste cans filled with soil. Earth ship also has its own solar panels and wind turbines to produce its own electricity and rainwater recycling system. It also has self-contained sewage treatment for reusing the waste water. Earth ship is also designed to produce its own food. Earth ship is very effective construction method without harming the nature.

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