

Rural and Slum Up-Gradation Using Solid Wastes

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Abstract-Poverty, increasing population and migration are the leading causes of slum in present scenario. These slums are causing various health hazards as well as deterioration of aesthetics of nearby area. Slum clearance and slum relocation totally eradicates the possibility of socio economic development of dwellers. Slum up-gradation helps in customization of basic amenities at the place where the slums exists. An appreciable amount of solid waste includes plastic, aluminum, rubber scraps and the large amount fly ash from the thermal power plant are generated. Only lesser amount of mentioned scraps gets recycled. But the remaining part can further be used as subsidiary building materials. Construction of houses by using plastic bottles filled with sand, cans and rubber tires not only provides low cost housing but also the passive heating system. This eco-friendly construction of housing lessens the solid waste and also incorporates in the aesthetics. A similar process of housing Earthship construction has taken place in Lakshwadweep, Tamilnadu but on a very small scale. Here we are thinking of introducing this technique for the up-gradation of slum and rural areas, and enhancing the better management of the solid waste materials.

Keywords- Slum up-gradation, solid waste, passive heating, earthship construction

I. INTRODUCTION

India, officially the Republic of India, is a country in South Asia. It is the seventh-largest country by area, the second-most populous country with over 1.2 billion people, and the most populous democracy in the world.

India, with 1,270,272,105 (1.27 billion) people is the second most populous country in the world, while China is on the top with over 1,360,044,605 (1.36 billion) people. With the increasing population in due course of decade, and the adoption of western culture leading to a large scale increase in the generation of solid waste.

Population Curve in Million

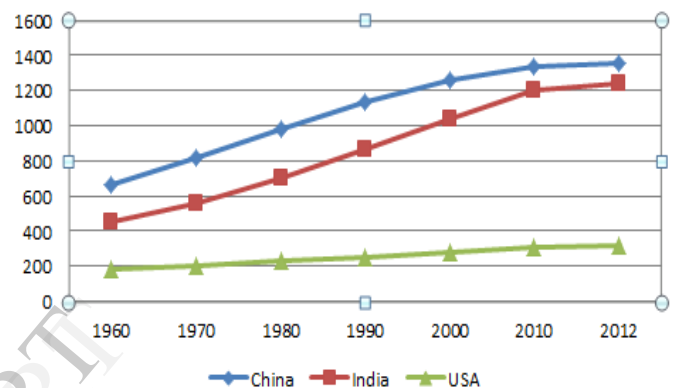


Figure 1.1- Population curve in million

Source include: World Bank, United States Census Bureau.

The increasing population is also leading to the uneven allocation of land and generation of slums in the cities and towns, which is becoming a major cause of aesthetic view and various health hazards to city dwellers.

II. LITERATURE REVIEW

The Earthship as it exists today began to take shape in the 1970s. Michael E. "Mike" Reynolds is an American architect based in New Mexico known for the design and construction of Earthship. His thesis was published in Architectural Record in 1971 and the following year he built his first house from recycled materials. The structures built under his direction utilize everyday trash items like aluminum cans, plastic bottles and used tires. Instead of using conventional (and energy-consuming) recycling methods, His Thumb House, built in 1972, used beer cans wired together into "bricks," which were mortared together and then plastered over.

III. BACKGROUND

Earthship construction technology is a housing technique in which scrap materials like worn out rubber tyres, plastic and glass bottles and steel cans are used. These type of houses built, overcomes the various systems taking place in our society and the problems and issues related to them.

Electrical energy production and distribution-This system provides electrical energy for light and appliances, for heating and conditioning, and also in some cases for water pumping for living compartment. In order for these systems to keep with the demand, they are producing hazardous by product which pollutes the environment. The price of this power, in term of money is high and increasing day by day. The price of these power in term of ecology, is the depletion of resources which took millions of years to form. It is no longer safe for us to use and their reliability questionable as we voyage into the future.

Water system-Talking about India where normally the water distribution in the cities and town is dependent on the river and some part on groundwater, but the ground water is depleting in a fast rate in quality and quantity both. Water systems always involve electricity in some way, so the water system is dependent on electrical system. Thus the purification and treatment of this water required a large scale utilization of electricity. Thus lacking many cities for good quality water.

Sewage system-In India cities normally all waste water goes into sewage systems. 60% of this water can be reused as grey water. In many cities of India this is not considered, hence results in a large amount of sewage to treat. The result is extreme pollution in and around the water near cities and large amount pollution of rivers.

Material system- The materials basically used for the construction purpose that force us to rethink over it.

- Large scale use of wood, which is a renewable resource but took a long time for tree to grow and generate that much amount of wood.

- Bricks which are a major part of construction are prepared using clayey soil which is available in a renewable resource but available in a fixed amount, and take a long period of time to form through natural weathering and other procedure.

- There is much energy involved in the manufacturing and processing of these materials which involve the large scale utilization of energy.

- Manufacturing and processing of these materials also generate a large amount of pollution, which is degrading the environment.

- All materials are not produced at all places and hence to be transported from one place to other thus become uneconomical.

IV. MATERIALS AND METHOD

Earthship construction uses sand filled bottles and cans for construction purposes. The houses constructed are generally

off grid houses and almost all of them are single story (without RCC slab) which will not match with the land use pattern in India.

Using the concept of earthship construction with some enhancements and changes in the technique for meeting the requirements in context of India, which is facing a large scale slum problem, their removal and proper land use, a new method of housing is proposed to be developed for slum and rural areas which will benefit the Indian government in providing houses with better facilities and sanitation systems in its most economical way and thus leading to the overall development of concerned areas. This concept of housing can also be utilized in urban areas up to some extent for minimization of several issues as mentioned above.

The enhancements prescribed in the proposed concept of construction are as follows-

1. Use of fly ash in filling of bottles replacing sand. As sand excavation from river beds is going out to be illegal as per Indian government. The reason of using flyash is its ample generation in various power generation processes and problems adhered to its disposal which lead to environmental issues.
2. Double story construction providing RCC slab and columns as per requirements and specifications.

Basic construction design-

Foundation-The foundation of these building consisted of layer of tires packed of full of gravel. The gravel serves as a capillary break to keep the lowest course of the walls dry. The gravels are used with soil, but the concentration of gravel is more than the soil, because if the soil is only used than it may swollen due to capillarity action leading to the increase in the volume in rainy season and during dry days further contraction leading to the instability of the foundation.

But as we are dealing with the double story construction so keeping this point in mind, we decided to provide a column and beam arrangement with a reinforced cement concrete slab.

It is also recommended that the moisture content of the soil being used is approximately 10%. A simple test of moisture content can be performed by making a small dirt ball in your hand that when dropped from shoulder height breaks into small chunks on a hard surface.

Walls- Walls that can be classified into two parts.

1. Main walls- These walls are the peripheral walls and they will be made from plastic bottles of 2 liters which are filled with fly ash to attain the appreciable strength. These are the common walls of the houses.
1. Partition walls- These walls include the partition walls of the houses and we decided to provide these walls from plastic bottles of 750ml which have a sufficient thickness.

The compressive strength attain by the bottles are as mentioned in the table below. While testing these bottles one interesting fact came across, the compressive strength of plastic bottles are about 3 times more than the brick. In general the brick fails at 9-10 ton load applied over it.

Table 4.1-Compressive strength of the plastic bottles filled with fly ash

S.NO	Type of Bottle	Weight of bottle after filling fly ash (in Kg)	Compressive Strength (in Ton)
01	Amul Lassi	0.259	30
02	Thumps Up	0.746	34
03	Mountain Dew	0.733	35
04	Pepsi	0.758	35

he walls will be made by using these plastic bottles which are put together by using clayey soil mortar. Which are further plastered in the ordinary way. In the absence of the clayey soil the ordinary cement mortar can be used.

The back walls of the ground floor will be made using the worn out tyres which are filled and rammed with the soil. And thus provide a stable wall.

Columns-Columns will be provide in the front row that is common among the two houses. These columns will be up to the first floor and two extra column will be placed in the back row between the ground and the first floor. And the slab to be provide will be of RCC.

On the basis of this an estimate is made that also drew the attention and shows the difference in cost.

Table 4.2-Estimate of 500 houses in double story construction manner using solid waste materials.

S.no .	Item	Quantity	Rate	Cost (In Rs.)
1	Brick Work	13322.2 m	3700 per m	49292140
2	D.P.C	360.6 per m ³	250 per m ³	90150
3	Concreting	495 per m ³	5100 per m ³	2524500
4	Reinforcem ent	15	46000	690000
5	Plastering	5455 m ²	140 per m ²	763700
6	Painting	5455 m ²	50 per m ²	272750
7	Fitting	12.5%		6704155
8	Labour Cost	20%		10726648
9	Transportat ion	10%		5363324
		TOTAL		76427367

Only the cost incurred by the fly ash transportation is not mentioned in the estimate. But as we know it's a solid waste material whose disposal is tough, hence we can assume that it will also be available at low cost or at no cost.

Table 4.3-Estimate of 500 houses in double story construction manner.Using
· simple brick construction

s.no	Item	Quantity	Rate	Cost
1.	12 no. tires	175000	Rs. 30 per tire	5250000
2.	2 Lt. Bottles	375000	Rs. 25 per kg.	625000
3.	750 ml. Bottles	1750000	Rs. 20 per kg.	1500000
4.	Bear Bottles	750000	Rs. 30 per kg.	2500000
5.	Bear Bottles	(3.8 x 3.2 x 0.1)x500 m ³	Rs. 7000 per m ³	4500000
6.	RCC Slab	(3.8 x 3.2 x 0.1)x500 m ³	Rs. 7000 per m ³	4500000
7.	RCC Column	(0.3 x0.2x2.4) x 1200 m ³	Rs. 7000 per m ³	1300000
8.	Plastering	5455 m ²	Rs. 140 per m ²	763700
7	Painting	5455 m ²	Rs. 50 per m ²	272750
9.	Labor Cost	6 labor	250 per day	6750000
10	Mason	2 mason	500 per day	4500000
11	Fittings	12.50%		3500000
12	Transportation	10%		2800000
		TOTAL		34261450

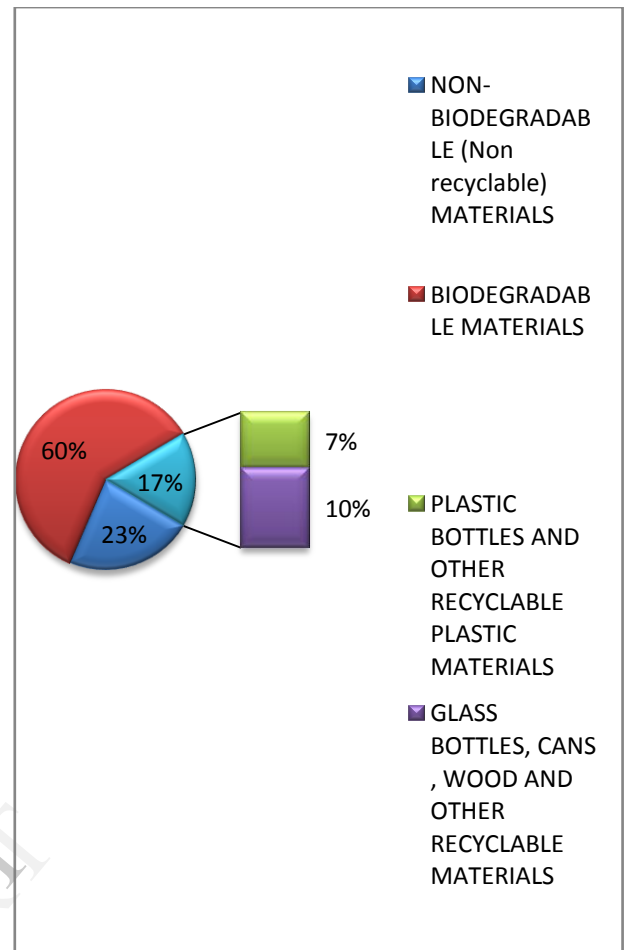


Figure 4.1- Amount of solid waste generation in Lucknow city

Source :- Jyoti Envirotech, Lucknow, U.P. (2012-2013)

The construction of houses using solid wastes is approximately 2 times cheaper than the construction of houses using simple brick construction. The difference in amount can be used in providing other basic facilities that include electricity supply using solar panel, water supply, roads facilities etc. This construction process will also generate a chance of better utilization of solid waste material and thus, generating an economic value from discarded solid waste material too.

Availability of these materials must not be a matter of disturbance as their occurrence is in ample of amount in present world scenario.

V. FEATURES OF THESE HOUSES

- The houses are based on solar heating passive system, which regulate the interior temperature of the house.
- The houses comprises of rain water harvesting technique, which will directly filtrate the rainwater in to the ground, thus enhancing the groundwater quality and the ground water table.
- The foundation of the houses will be based on tyres which are more resistant to concrete foundation during earthquake.
- Extra foundation for the walls is also not required as they are thicker than ordinary brick walls.
- The houses will be equipped with continuous water supply, fit for drinking and other purposes.
- The water from the kitchen after filtration will directly be passed into the nearby plants, trees, planted in the locality, as this water is good for the plant growth.

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