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SIMULATION OF LOW COST GREEN BUILDING CONSTRUCTION TECHNOLOGIES

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ABSTRACT

Green building practices aim to reduce the environmental impact of buildings. Green buildings are also known as sustainable or high performance building. It practices emerged to alleviate the effects of the increasing the impact on the environment and to improve the building construction process. In this context 5Rs (Reduce, Reuse, Recycle, Rethink, Recover) are provided, Reduce the resources like renewable and non-renewable, reuse the items as much as possible, existing components are put to some new purpose (recycle).

Rethink about the impact of environment before using the resources; Recover the waste products to use. The experiment showed a promising result where by the indoor temperature dropped down 6ºC to 10ºC with green building technologies. As a result, provides solutions to environmental problems and contributes in keeping the environment clean and green. It aims that green buildings are only way to a sustainable future mitigate.

KEYWORDS: Green Building, Rat Trap Polystyrene Bond, 5R Technologies, Energy Saving Buildings

INTRODUCTION

A green building is a structure that is environmentally responsible and resource-efficient throughout its life-cycle. These objectives expand and complement the classical building design concerns of economy, utility, durability, and comfort. Green buildings are designed to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, building materials (eg.: use of rat trap polystyrene bond) and other resources)
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environment degradation
- Green buildings may incorporate sustainable materials in their construction (e.g., reused, recycled-content, or made from renewable resources);
- Create healthy indoor environments with minimal pollutants by the special plants

REDUCE (RAT - TRAP POLYSTRENE BOND)

Buildings account for a large amount of land use, energy, water consumption, and air and atmosphere alteration. Here to introducing the RAT-TRAP POLYSTRENE bond walling, it is a cavity wall construction with added advantage of thermal comfort and reduction in the quantity of bricks required for masonry work, to improve the thermal comfort more adding thermocol in this cavity wall structure. It is basically called as expanded poly - styrene.

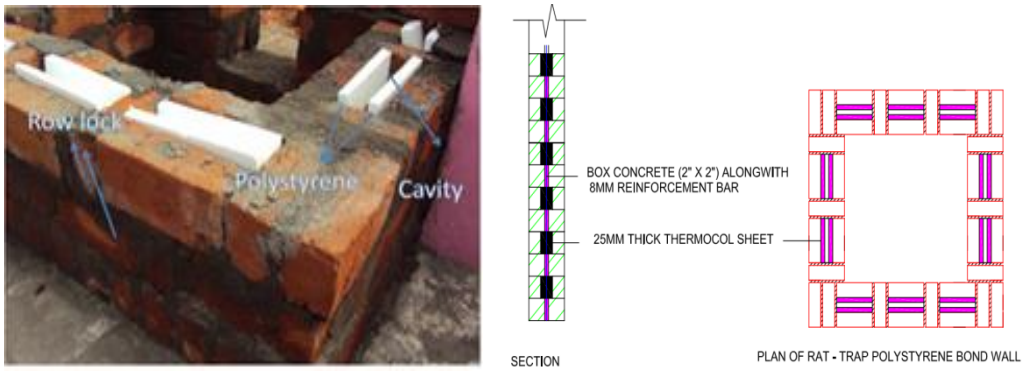

Figure 1

The Rat trap polystyrene bond construction is a modular type of masonry construction. Due care must be taken while designing the wall lengths and heights for a structure. The openings and wall dimensions to be in multiples of the module, also the course below sill and lintel to be a solid course by placing bricks on edge. The masonry on the sides of the openings also to be solid as will help in fixing of the opening frame.

CONSTRUCTION PROCEDURES

- First bottom layer should be continued in header bond pattern.
- From second layer to bottom of top most layers to be constructed as per the figure shown.
- Introducing polystyrene sheet 2 layers (25mm thick) at the bond cavities.
- Lintel must be in brick lintel.
- Top most layer cavities should be covered by the polystyrene sheets.
- Beam and column free structures. It will withstand up-to 2 floors.
- RCC roof slab thickness can be reduced as per the design requirement than conventional slab

Figure 2

ADVANTAGES OF USING RAT TRAP POLYSTYRENE BOND

- By adopting this method of masonry, you can save on approx. 20-35% less bricks and 30-50% less mortar; also this reduces the cost of a 9 inch wall by
- 20-30 % and productivity of work enhances.
- For 1 m of Rat trap bond, 470 bricks are required compared to conventional brick wall where a total of 550 bricks are required.

- Additionally 25mm thermocol (polystyrene) sheet 2 no's to be used for thermal comfort.
- Rat trap bond wall is a cavity wall construction with added advantage of thermal comfort. The interiors remain cooler in summer and warmer in winters.
- Rat-trap bond when kept exposed, create aesthetically pleasing wall surface and cost of plastering may be avoided.
- Rat trap bond can be used for load bearing as well as thick partition walls.
- All works such as pillars, sill bands, window and tie beams can be concealed.
- The walls have approx. 20% less dead weight and hence the foundations and other supporting structural members can suitably be designed, this gives
- An added advantage of cost saving for foundation.
- Service's installations should be planned during the masonry construction if not exposed.
- Virgin materials such as bricks, cement and steel can be considerably saved upon by adopting this technology. It will also help reduce the Embodied
- In case for more structural safety, reinforcement bars can be inserted through the cavity till the foundation.

X axis indicating the time & Y axis indicating the temperature (ºC / ºF) Ref - Figure 3 & 4

Table 1

X Axis	Time
1	10:00 AM
2	12:00 PM
3	2:00 PM
4	4:00 PM
5	5:00 PM
6	7:00 PM
7	8:00 PM
8	6:00 AM

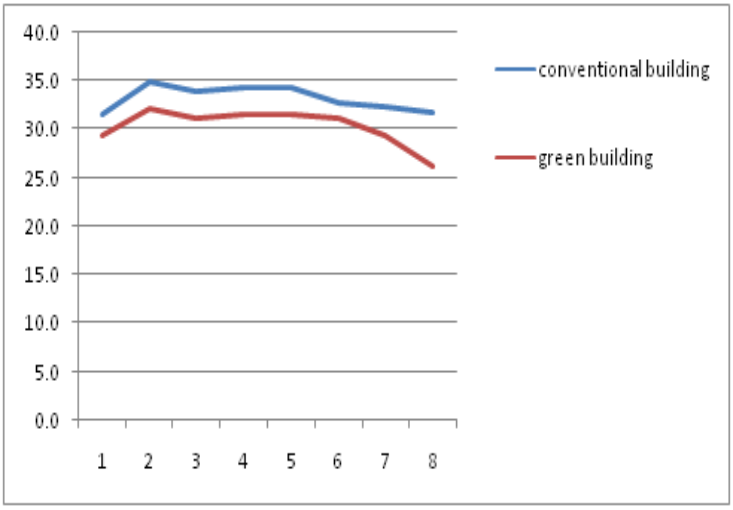

Figure 3

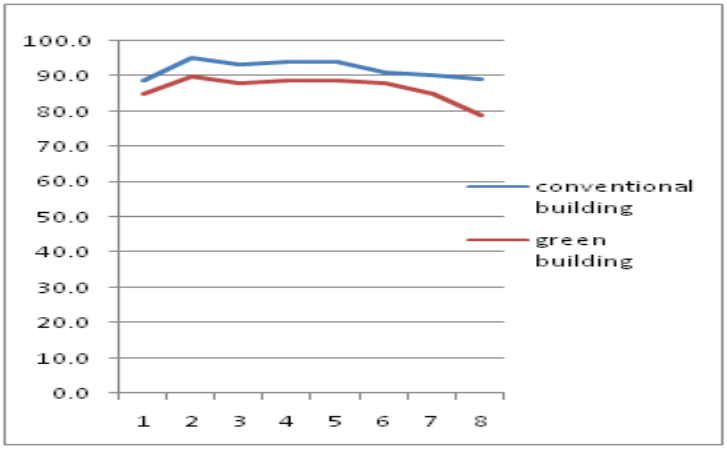

Figure 4

SAVINGS (per cum)

Bricks (0.225X0.113X0.075m) required 527 no's for conventional bond.

Bricks (0.225X0.113X0.075m) required 400 no's for Rat - trap bond. (Actual quantity is 378 No's only, bottom layer and sill level bottom; lintel is a normal bond, so consider 5% more in a actual quantity) Brick savings 127 No's (24%)

Table 2

S.No	Description	Unit	Normal	RTPB	Savings
1	Cement for brickwork (1:5 - mortar)	bag	1.68	0.5	1.18
2	sand	cum	0.294	0.078	0.216
3	Polystyrene sheet 25mm thick	sqm	0	1.43	**-1.43**

REUSE

Gray water is waste water that has the potential for reuse. To be considered gray water, or sullage, there must be no human/organic waste (feces) or toxic chemicals. Such sources would include water from normal sink use and shower/bathtub use, or at times used wash water from clothes or dish washing units. This partially used water can be recycled for irrigation or used to flush toilets. Gray water is not potable and there are varying degrees of purity (dark gray to “black water” being most heavily used). With partial filtration, or even with no treatment, gray water can be a valuable and reusable resource.

IS 1172 to understand the break-up of this demand which was then put as 135 litres per person per day. The break-up was as follows:

Bathing : 55 litres

Toilet flushing : 30 litres

Washing of clothes : 20 litres

Washing the house : 10 litres

Washing utensils : 10 litres

Cooking : 5 litres

Drinking : 5 litres

Gray water quantity - 125 litres/person/day. To get the treated gray water around 100 litres after the evaporation, penetration loss at the treated water storage pit (Ref figure 2). Attached motor is pumping the treated gray water from water storage pit to engaged water tank, from that water is distributing by the gravitational force to flush toilet tank.

Table 3: pH Values of Gray Water before Treatment

S.No	Source	pH Value
1	Shower	5 to 8.1
2.	Laundry	9.3 to 10
3	Kitchen sink	6.3 to 7.4

pH values of after primary treatment of house gray water 6 to 9.

The requirement of toilet flush water pH value is 6 to 9. So this primary treated water can be used to flush toilet tank.

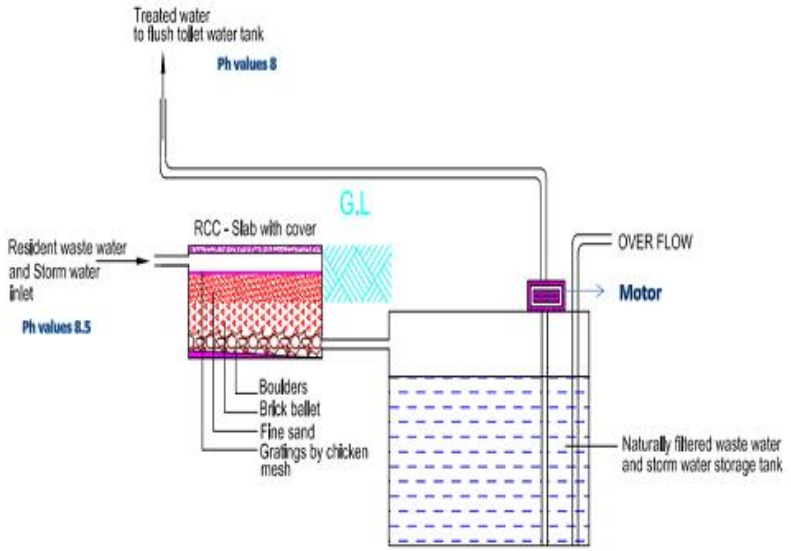

Figure 5

The characteristics of gray water produced by a household will vary according to the number of occupants, the age distribution, lifestyle, health status and water usage patterns.

There are essentially three different gray water streams, they are:

Source (Environmental Health Directorate of the Department of Health, 2005).

Table 4

S.No	Source	Contaminated	Percentage of Gray Water
1	Bathroom (Bath, Basin, and Shower)	hair, soaps, shampoos, hair dyes, toothpaste, lint, body fats, oils and cleaning products	55
2	Laundry	lint, oils, greases, chemicals, soaps, nutrients and other compounds	34
3	Kitchen	food particles, cooking oils, grease, detergents, dishwashing powders	11

Physical methods include processes where no gross chemical or biological changes are carried out and strictly physical phenomena are used to improve or treat the wastewater.

Examples would be coarse screening to remove larger entrained objects and sedimentation (or clarification).

In the process of sedimentation, physical phenomena relating to the settling of solids by gravity are allowed to operate. Usually this consists of simply holding a wastewater for a short period of time in a tank under quiescent conditions, allowing the heavier solids to settle, and removing the "clarified" effluent. Sedimentation for solids separation is a very common process operation and is routinely employed at the beginning and end of wastewater treatment operations. While sedimentation is one of the most common physical treatment processes that are used to achieve treatment, another physical treatment process consists of aeration -- that is, physically adding air, usually to provide oxygen to the wastewater. Still other physical phenomena used in treatment consist of filtration. Here wastewater is passed through a filter medium to separate solids. An example would be the use of sand filters to further remove entrained solids from a treated wastewater. Certain phenomena will occur during the sedimentation process and can be advantageously used to further improve water quality. Permitting greases or oils, for example, to float to the surface and skimming or physically removing them from the wastewaters is often carried out as part of the overall treatment process.

RECYCLE

Meaning of recycle is "ensure used items or their components are put to some new purpose as much as possible" Here going to recycle the house kitchen waste to compost. Depletion of resources, growing demand for secondary raw materials, increasing production of waste…these are many of the issues the planet must now face. By 2020, the OECD (Organisation for Economic Co-operation and Development) predicts waste production to have increased more than 45 % compared to 1995. It is therefore essential that we limit the impact of waste on the environment, as well as recover it to create new energy resources.

Figure 6

The majority of organic waste can be made into a superb fertilizer which will be ideal for garden and plants. Natural fertilizer is a great alternative to many artificial brands currently on the market. Creating compost is becoming more and more popular. The process is simple, quick and can allow creating a large amount of fertilizer in a short space of time.

Step One - Collect Household Waste

Think carefully about the food products you are throwing away and whether they can be beneficial to making a fertilizer. Avoid oils, grease, milk products and fatty meats because these will only serve to make your compost a slushy mess. The things you should be on the lookout for are peelings from fruit and vegetables, nuts, eggshells and over-ripened fruit. Also, make sure you can get your hands on some wood ash as this helps the composting process. This will be easy if you have an open fireplace.

Step Two - Collect Garden Waste

Save all leaves and clippings from any gardening work you do. Nothing will make the fertilizer more productive than a healthy amount of natural waste. Consider laying the leaves and garden waste around your lawn before you cut the grass. As your lawnmower goes over the top, it will suck in the waste and mix it with grass cuttings. You can then empty the lawnmower onto your compost heap. Nearly all excess garden clippings can be put into the compost mix although it should ideally be added over a period of days for the ideal effect.

Step Three - Other Materials to Include

Another organic material you can include is sawdust. Piles of sawdust can accumulate if you have been sawing wood or you can purchase large bags of it from any good gardening store. If you have your own livestock, add some of the manure to the compost pile. You can buy this in small amounts from nearby farms or from other locations that keep animals.

Step Four - Create Compost

Place all of your compost materials into a compost barrel. This barrel should be slightly raised from the floor and should have a handle which you can turn to rotate the barrel and the compost. Spin the barrel at least two times per day. This will make all of the compost materials mix together and combine natural benefits to make a very effective fertilizer. Make sure the barrel has a couple of slits down the side to allow moisture to escape as the barrel is turned.

Step Five - Spread

Once your compost has turned into a dark and soil-like mixture, it is ready to be spread. Use a large garden fork to pick the compost up and throw it over areas you would like to fertilize. Do not be afraid to be generous but remember that the compost is only a growing aid. Allow the compost layer to seep in and take effect before you fork on another load.

Figure 7

Figure 8

Figure 9

RETHINK

It is added to the front of the green technologies hierarchy, meaning that we should consider our options and think about their impact on the environment.

Some decorative indoor plants have the power to effectively remove all harmful volatile organic compounds, or VOCs, from the air. VOCs are chemicals such as benzene, xylene and octane. These are known to cause cancer and other health problems — disease which the World Health Organization reports kill more than 1.6 million people each year.

If that doesn't alarm you, consider this: VOCs are emitted by paint, varnishes, adhesives, furnishings, clothing, solvents, building materials, tap water and more. People spend 90 percent or more of their time inside. Indoor air has been reported to be as much as 12 times more polluted than outdoor air in some areas.

Not only are indoor plants beneficial for increasing oxygen levels in our homes, they have also been found to reduce the toxins in the air we are breathing.

We hear a lot about air pollution, mostly the outdoor kind caused by car exhaust and industry waste, but what about indoor air pollution? Because we spend the majority of our time in our homes and offices, indoor air pollution can have a very detrimental effect on our health, so much so that NASA conducted a study on how effective houseplants are at cleaning indoor air. Results showed that certain houseplants are actually quite efficient at removing from the air the three most common indoor chemicals:

Table 5

S. No	Toxic	Sources	Effects	Suggested Plants
1	Benzene	Plastics, dyes, rubbers, detergents and gasoline	Irritable to skin and eyes, respiratory and psychological disturbances, liver, kidney damages, blood and lymphatic systems	Spider plant
2	Trichloroethylene	varnishes, adhesives and metal degreasing	liver carcinogen, respiratory and central nervous system	Chinese evergreen
3	Formaldehyde	Insulation, particle board, carpet backing, grocery bags and paper towels.	leading causes for the development of asthma	Snake plant

Below is a list of the best houseplants to get rid of the above chemicals.

- English Ivy (Hedera helix)
- Spider plant (Chlorophytum comosum)
- Golden pothos or Devil's ivy (Scindapsus aures or Epipremnum aureum)
- Peace lily (Spathiphyllum 'Mauna Loa')
- Chinese evergreen (Aglaonema modestum)
- Bamboo palm or reed palm (Chamaedorea sefritzii)
- Snake plant or mother-in-law's tongue (Sansevieria trifasciata 'Laurentii')
- Heartleaf philodendron (Philodendron oxycardium, syn. Philodendron cordatum)
- Selloum philodendron (Philodendron bipinnatifidum, syn. Philodendron selloum)
- Elephant ear philodendron (Philodendron domesticum)
- Red-edged dracaena (Dracaena marginata)
- Cornstalk dracaena (Dracaena fragans 'Massangeana')
- Janet Craig dracaena (Dracaena deremensis 'Janet Craig')
- Warneck dracaena (Dracaena deremensis 'Warneckii')
- Weeping Figure (Ficus benjamina)
- Gerbera Daisy or Barberton daisy (Gerbera jamesonii)
- Pot Mumor Florist's Chrysanthemum (Chrysanthemum morifolium)
- Rubber Plant (Ficus elastica)

Figure 10

Of all the different oxygen producing plants, this one is unique since it converts a lot of CO2 (carbon dioxide) to O2 (oxygen) at night, making it ideal to have several in your bedroom. 6-8 waist high plants are needed per person to survive if there is no air flow (meaning you could live in a completely air sealed room if you had these plants and the Areca Palms present). The snake plant also removes formaldehyde from the air.

RECOVERY

Meaning of recovery in green technologies "recover the used renewable and non renewable resources as much as possible" and "to the practice of putting waste products to use"

Oxygen is produced as a waste product by plants in the process of photosynthesis. They produce tons and tons of it too! A single tree can make about 260 pounds of oxygen in one year.

"A single mature tree can absorb carbon dioxide at a rate of 48 lbs. /year and release enough oxygen back into the atmosphere to support 2 human beings."

McAliney, Mike. Arguments for Land Conservation

Documentation and Information Sources for Land Resources Protection, Trust for Public Land, Sacramento, CA, December, 1993

In the cement manufacturing unit produces 1 ton of CO_2 every products of 1 ton of cement. By this green technology CO_2 spacing's are to be filled by O_2. In this simulation building takes 25 Kgs of cement. While manufacturing time 25Kgs of CO_2 mixed with atmosphere. This emitted Co_2 replaced by O_2 within a year by one mature tree.

The air we breathe in is actually 78% nitrogen, 21% oxygen, and 1% other. We breathe out about 18% oxygen, 78% nitrogen, 3%carbon dioxide and water vapor

Calculations

Table 6

Human takes air (normal tide volume)	500ml air / breath
Non functioning areas (dead space)	150ml air / breath
Actual intake air quantity	350ml air / breath
Average breath per minute	12
12 X 350 = 4200 ml / min X 60	252000 ml / hour
3% of Co2	252000 X 3 / 100= 7560ml/hr (or) 7.56 litre/ hour
1 year Co2 emitted quantity by one person	=7.56 X 24 X 365 (or) 66225.6litre / year
1 Kg of Co2 = 570 litre of Co2	
One mature tree absorbs 22 Kg of Co2	
Approximately 5mature trees are required to absorb human exhaled Co2 in a year	

CONCLUSIONS

India has always faced an acute housing problem due to growing population and unaffordable building costs. By that occupants and environmental gets more decease, for these issues green building is an only solution. But the initial cost increment in green building is the most common of barriers. But in this paper, dealing rat trap polystyrene bond, from that initial cost itself can be reduced. So it is an energy efficiency low cost building technology, and other mentioned technologies helped to some extent in recycling and reuse of resources as well as development of human resources. Plantation will absorb CO_2 from atmosphere and reduce the green house effect even gives pleasant look. Indoor air quality plants are reducing the dust and other airborne particles and give the green environment for occupants. By providing green roofs, cavity walls, heat barriers, on the outer face of the wall, we will reduce the temperature about 6ºC to 10º C. In today's era Green Buildings are essential as environmental balance is very important for survival and further development of human beings. Green Buildings are only way to a sustainable future.

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