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DEVELOPMENT OF SELF-SUSTAINABLE TOWNSHIP WITH THE HELP OF VARIOUS SMART CITY CONCEPTS

BY USING REVIT ARCHITECTURE

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ABSTRACT

The term town planning is used to indicate the arrangement of various components or units of a town in such a way that the town as such attains the significance of a living organism. It also includes ways and means to be adopted for the improvement of the existing towns or for the extension of the towns. The town planning is a science as well as an art too. The town planning, however, is not an exact science and precise forecast of future possibilities are not attainable. But the gap between guesswork and prediction can be brought down to a minimum by the cooperation of various agencies involved in the use and development of land.

KEYWORDS — Rain water harvesting, Green construction materials, HVAC concept, and Solar energy.

INTRODUCTION TO TOWN PLANNING

The town planning is a science as well as an art too. The science consists in collecting, correlating and analysing the facts about a town. The art lies in arranging the components of a town in such a way that the final result is in the form of beautiful, convenient, economical, and efficient unit. Thus, science and art must not and cannot sit apart when a new town is being designed or when an existing town is being remodelled. The science and art must join their hands and work as co-partners in the difficult task of bringing out a well arranged town.

The town planning, however, is not an exact science and precise forecast of future possibilities are not attainable. But the gap between guesswork and prediction can be brought down to a minimum by the cooperation of various agencies involved in the use and development of land.

PRINCIPALS OF TOWN PLANNING

The 8 basic principles of town planning are as follows:-

- The scope of city planning consists of principally in fixing the baselines of all traffic movements and transit facilities, including streets, railroads and canals.

- The street network should be planned in such a way that the main streets with the existing streets have to be given greater consideration
- Some parts of the city have to be grouped in accordance with the location of the part and individual characteristics
- The building departments have to adhere to by some rights and privileges related to fire protection; freedom from interference; health and safety of buildings and all aesthetic considerations.
- The town or city municipal authorities have to facilitate for legal measures in cases of expropriation and impropriation
- The property holders, who are directly benefited by improvements, have to reimburse the city by paying funds in advance to the city for such a purpose
- The municipality has to constantly supervise the activities of interested property owner s associations, in regard to the improvement of certain sections.
- Efficient use of land and infrastructure: Land upon which it is necessary to make improvements should only be built upon under reservations for its subsequent use by the city.

LITERATURE REVIEW

1. RAIN WATER HARVESTING: - It was very difficult to imagine few decades before that you will require to buy drinking. The use value of water was never undermined, but it's about time that even its exchange value is given due importance. Fresh water today is a scarce resource, and it is being felt the world over. More than 2000 million people would live under conditions of high water stress by the year 2050, according to the UNEP (United Nations Environment Program), which warns water could prove to be a limiting factor for development in a number of regions in the world.
About one-fifth of the world's population lacks access to safe drinking water and with the present consumption patterns; two out of every three persons on the earth would live in water-stressed conditions by 2025. Around one-third of the world population now lives in countries with moderate to high water stress—where water consumption is more than 10% of the renewable fresh water supply, said the GEO (Global Environment Outlook) 2000, the UNEP's millennium report. Pollution and scarcity of water resources and climate change would be the major emerging issues in the next century, said the report.

2. GREEN CONSTRUCTION MATERIALS: - Green materials are the materials which are used for construction purpose of various civil structures. These materials are used to make the environment green. Using of plastic in construction of roads improves the quality of road and reduces the disposal of growing plastic while as fly ash is used for manufacturing bricks because for manufacturing clay bricks the top soil is been used in a large amount, so using fly ash reduces pollution and use of top soil in a large quantity.

3. HVAC CONCEPT: - HVAC systems may damage the environment by unnecessary use of energy which results in depletion of non-renewable energy resources, either by the generation of electricity or thermal energy, both of which contribute to environmental pollution [Centre for 3 Construction Ecology, 1998]. Environmental damage by HVAC systems may also be caused by Appearance or noise, and by the discharge of contaminated water and air containing chemicals, Lubricating oils, refrigerants, heat transfer fluids, particulate or gaseous matter, or microbiological organisms. In most situations, HVAC systems will significantly impact how "green" a building is. Therefore, the project team should not overlook the potential and influence when developing the design.

4. SOLAR ENERGY: - Solar power is the conversion of sunlight into electricity, either directly using photovoltaic (PV), or indirectly using concentrated solar power (CSP). Concentrated solar power systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. Photovoltaic convert light into an electric current using the photovoltaic effect.

PROBLEM FORMULATION

1. ABOUT TOWNSHIP PROJECT: - Our first effort in the aforementioned area is a 30 acre project where we intend to develop an integrated township of Green homes with following features:

- Lush Green Campus
- Green homes with most tangible benefits of energy savings 20 -30 % and water savings 30% to 50%.

- Enhanced air quality and day lighting.
- Energy efficient infrastructure.
- A sustainable environment for its occupants.
- Recreational facilities for kids' growth.
- A campus that's easy to use for the disabled.
- Low maintenance cost for the resident's welfare.
- Rain water harvesting
- Green construction material

This township is going to revolutionize the way the people. This is the ideal opportunity to for all citizens of this city to upgrade to beautiful living at affordable prices.

TABLE 1

TYPE OF AREA	AREA IN (ACRES)
Total area of Town	30
Min. Open space required (25% of total area)	7.5
Open space provided	9

2. TOWNSHIP CONTENT: - This Town contents various types of Buildings such as Commercial, Residential, and Public Buildings etc.
In Residential Buildings Row Houses, Royal Bungalows, Semi-detach and Apartments are provided. In Public Buildings, there are Primary school, Club house and Bus stops are provided. And in Commercial buildings, Commercial complex is provided.

TABLE NO. 2

SR. NO.	TYPE OF BUILDING	NAME OF BUILDING	TOTAL NO. OF BUILDINGS	TOTAL AREA (M^2)	REMARK
1.	Residential Buildings	Row Houses (Type-1)	16	1707.5216	1BHK
2.		Row Houses (Type-2)	20	3959.2702	2BHK
3.		Royal Bungalows (Type-1)	10	13114.5200	2BHK
4.		Royal Bungalows (Type-2)	12	3949.7346	4BHK
5.		Semi-detach Bungalow (Type-1)	10	1425.9419	1BHK
6.		Semi-detach Bungalow (Type-2)	24	6765.9888	2BHK
7.		Apartment (Each 10 Floors)	7	15777.8482	4 Flats of each 1BHK & 2BHK on each floor
8.	Commercial Buildings	Commercial Shops	1	3577.7164	Includes Shops, Clinic, any other etc.
9.	Public Buildings	Bus Stop	2	303.7606	-
10.		Club House	1	5049.0389	-
11.		Primary school	1	3208.4515	Nursery to 5th standard
12.	Open Space	-	-	37513.0435	Used for Gardening, Landscaping, Treatment plant, Road etc.
13.	Future scope	-	-	25052.8568	Reserved of Future scope

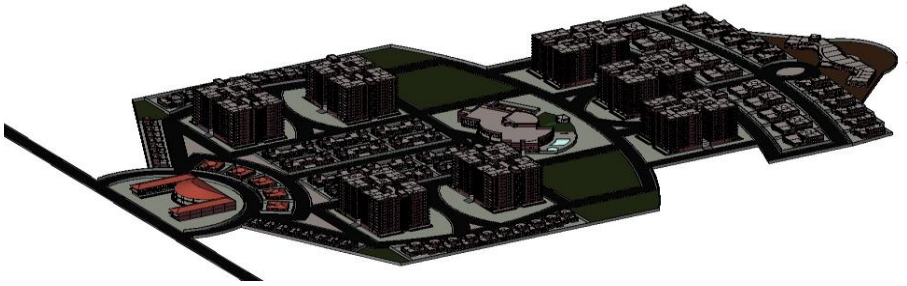

Fig. 1 Town-city Layout

PARAMETRIC STUDY

1. **RAIN WATER HARVESTING**: - Calculate potential supply of rain water from the catchment area:

Mean rainwater supply in m^3 = Mean annual rainfall in mm/year (Need to convert this vale in 'm') X Surface area of catchment in m^2 X Run-off coeff.

Type of catchment = Rooftop catchment area made of Concrete.

Mean annual rainfall in = 560.54 mm/year

Surface area of catchment = 18450 m^2

Run-off coefficient = 0.6

Mean rainwater supply =560.54mm/year X 18450m^2 X 0.6

Mean rainwater supply = 6205 m^3 (62, 05, 177 Litres)

Required data calculation:

Total area of town =30 acres (121405.693 m^2)

Landscaping area = 20% of total town

= 24281.1386m^2

Population in town = 5000

TABLE NO. 3

S. No	Description	Amount of water in lit/head / day	Population of Town/ Area to Watering	Total amount of water	
				Per day	Per year
1	Bathing	55	5000	275000	100375000
2	Washing of clothes	20	5000	100000	36500000
3	Flushing of W.C.	30	5000	150000	54750000
4	Washing the house	10	5000	50000	18250000
5	Washing of utensils	10	5000	50000	18250000
6	Cooking	5	5000	25000	9125000
7	Drinking	5	5000	25000	9125000
8	Road washing	5	5000	25000	9125000
9	Sanitation	5	5000	25000	9125000
10	Public parkas or landscaping	3 lit./sq. m/day	28327.99m^2.	849834	310189410
Total				1574834 lit/day (1574.835m^3/day)	574814410 lit/year (574814.41m^3/year)

Water demand for public parks and landscaping is about 8, 49,834 lit/day. However, this demand can be satisfied by the rain water harvesting with some extent. The total collected rain water during rainy session is about 62, 00,000 lit/year

2. GREEN CONSTRUCTION MATERIAL: -

a. CONSTRUCTION OF ECO-FRIENDLY ROAD: – The plastic waste quantity in municipal solid waste is increasing due to increase in population and changes in life style. Thus disposal of waste plastic is a hazardous and become a serious problem globally due to their non-biodegradability. Plastic roads are found to perform better than ordinary roads and therefore use of plastic road construction has gained importance these days. Disposal of waste plastic bags has become a serious problem and waste plastics are burnt for disposal which causes environmental pollution. Utilization of waste plastic bituminous mixes has proved that these enhance the properties of mix in addition to solving disposal problems. Waste like plastic bottles, polymers, cups, etc. can be re-used by powdering or blending it with crusher and can be coated over aggregate and bitumen by any heating process. When you hear the word 'plastic', it's usually followed by a twitch of the eyebrow and a nod of the head. Plastics are also called as synthetic resins.

Causes of using waste plastic in road construction:

- Disposal of plastic waste by land filling or burning is not Eco-friendly therefore an urgent need of alternate use of waste plastic.
- Utilization of plastic waste in bitumen mix to improve the properties of the binders, which can prove to be a promising alternative.
- Recent studies in this direction have proved that the fatigue life is doubled and resistance to rutting and water damages increased when plastic waste is used.
- Gives higher strength
- Resistance towards water stagnation, i.e. No pot holes are formed.
- Less blending during summer
- Higher Marshall stability
- Burning of plastics waste could be avoided
- Lower maintenance costs
- Reduction in consumption of bituminous mix.
- This technology would help to produce better roads with longer service life and would also be economical as there would be considerable savings in the ever increasing costs of bitumen & also protect the environment.
- Cost of waste plastic around Rs.6 per Kg vice-versa cost of bitumen being around Rs.14 per Kg. Hence there was a saving in cost of road construction also.
-

Specifications for Waste Plastic: The following types of waste plastic can be used in the construction of rural roads:

- Films (Carry Bags, Cups) thickness up to 60micron (PE, PP and PS)
- Hard foams (PS) any thickness
- Soft Foams (PE and PP) any thickness.
- Laminated Plastics thickness up to 60 micron (Aluminium coated also) packing materials used for biscuits, chocolates, etc.,

Please note that Poly Vinyl Chloride (PVC) sheets or Flux sheets should not be used in any case.

b. FLY- ASH BRICKS :- Comparison between normal bricks i.e. clay bricks and Fly ash bricks are followed:

TABLE NO. 4

Fly ash Bricks	Clay bricks
10-12% water absorption	20-25% water absorption
Rs 3/- per brick	Rs 5/- per brick
Eco-friendly	Harmful
High compressive Strength (10-12 N/mm2)	Low compressive strength (3.5 N/mm2)

3. HVAC CONCEPT: - It describes the role of Heat, Ventilating and air-conditioning (HVAC) for ensuring high performance green buildings in design and operation. The design strategies for effective and green HVAC systems are

explained and the new emerging HVAC technologies for green buildings are described. It is hoped that HVAC designers and other building professionals could develop a better understanding of green buildings and apply effective strategies and techniques for meeting the goal. With an integrated and holistic approach to HVAC and building design, a sustainable built environment can be achieved and the environmental Performance of buildings can be improved.

4.

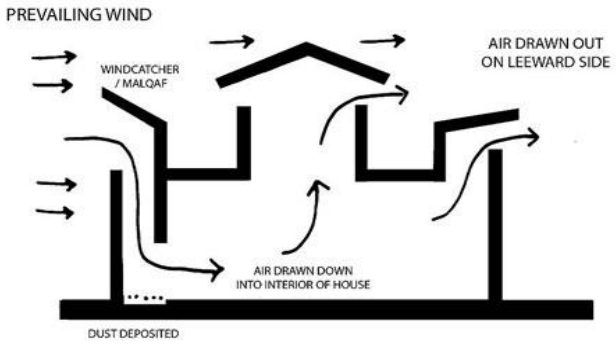

Fig. 2 HVAC – Air ventilation

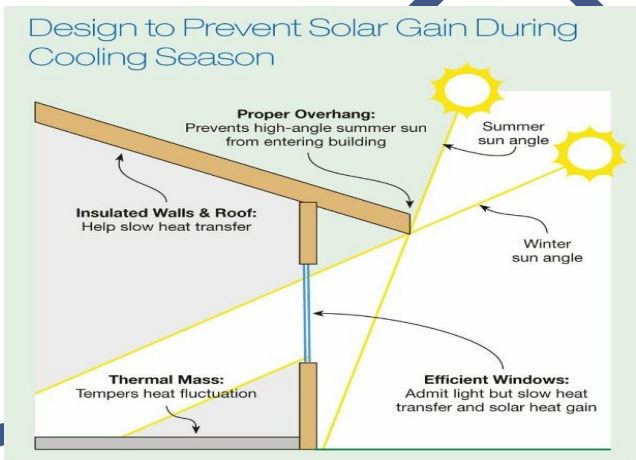

Fig. 3 HVAC - Heating

4. SOLAR ENERGY: -The average household, about 4500 kWh of electricity every year and solar PV panels usually generate about 40 percent of this, or 1850 kWh per year. According to the above reference, the total number of families is 374, for this, the minimum electricity require is 16, 83,000 kWh per year. Out of this required electricity, 6, 73,200kWh per year can be generated from solar PV panels.

TABLE NO. 5

No. of house-hold	Electricity consumption per year in (kWh) (1)	Electricity generation by using solar panels (kWh) (2)	Total consumption of electricity (kWh) (3) (1)-(2)=(3)	Save in electricity (%)
1	4500	1850	2650	40
374	1683000	673200	1009800	40

Fig. 4 Solar Panels used in Roof materials

CONCLUSION

1. By using Rain water harvesting we conclude that, it saves water and collected rain water can be used for landscaping and Public Park.
2. By using Green construction materials, we can make clean environment and it is step toward "SWATCH BHARAT".
3. Using Solar energy, we can save up to 40 % of electricity.
4. By using HVAC concept, we can use maximum utilization of natural resources to create healthy environment.

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