

THE WAY WE LOOK AT THE BUILDINGS TODAY GREEN HILLS, ONGC- A CASE STUDY

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INTRODUCTION

Buildings have major environmental impacts along with our economy, personal health and productivity. They are one of the major pollutants that affect urban air quality and contribute to the climate change. Several buildings processes and occupant functions generate large amounts of waste and poses a major challenge to the environment. As per the LEED, globally, buildings are responsible for at least 40% of energy use, water consumption is estimated to 42%, raw materials used in manufacturing, construction and operation processes consumes estimated 50% of global consumption, contributes 50% of the world's air pollution, 42% of green house gases and 50% of all water pollution. In India too, the energy consumption has seen an increase and would continue to rise unless suitable actions to improve energy efficiency are taken up immediately. So, the structures should be designed, constructed and operated in the ways that they eliminate adverse impacts and enhance positive impacts. Construction should be such that it takes care of the environmental issues and efficiency of resources used throughout the phases of construction to maintenance, to renovation and to deconstruction. Analyzing the hazardous affects of the environment, breakthrough in the building design, science and technology has appointed green designers, builders, operators and owners to help maximize both the economic and environmental potential of the buildings. This practice expands and compliments the classical building design in terms of economy, utility, durability and comfort. Moreover, these new technologies complement the current practices in creating green structures, using energy, water and other resources efficiently; improving and protecting occupants health and reducing water pollution. 'Green Building' is the solution to all , the essence of which is to address all these issues in an integrated and scientific manner. Aim of the Green building design is to minimize the demand of non-renewable resources when in use and maximize the reuse , recycling and utilization of renewable resources. Resource intensive materials give structure to a building and landscaping adds beauty to it. Comfort to the occupants is achieved by the energy consuming systems for lighting, air conditioning and water heating. Building becomes hi-tech and intelligent as it responds efficiently to the varying conditions and intelligently monitor security and usage of fire fighting systems and other systems of resources in a controlled manner. Green building maximizes the use of efficient building materials and construction practices and depletes the natural resources to a minimum during the construction and operation. It is not only architect who evolves the buildings through his design process , but a team work of architects, landscape designers, qualified experts for air conditioning, electrical, plumbing and energy consultants are involved to address all aspects of building and system planning, designing, construction and operation. After evaluating each design decisions collectively and critically they evolve the viable design solution, known as Green Building. Green Building not only looks into the building design but also the Site Planning , Building System design which includes HVAC, Lighting, electrical and water heating, water and waste management, usage of sustainable material that have high recycled content, resource with low emission potential, indoor having a maintained thermal, visual control and air quality, along with energy generated on site with renewable energy sources.



Figure Schematic diagram highlighting selected green building features

Source: Internet

LEGEND

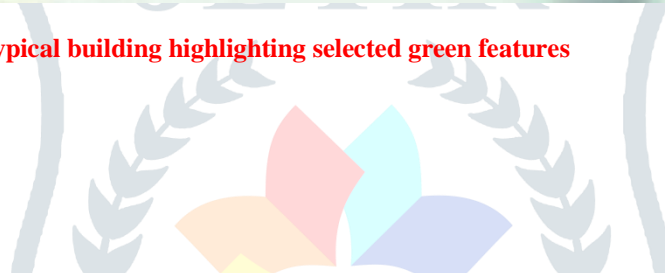
EXPERTS INVOLVED

1. SHADED CAR PARKING- LANDSCAPE DESIGNER
2. GRASS PAVING - LANDSCAPE DESIGNER
3. TREES SHADING THE BUILDINGS FROM SUMMER SUN-LANDSCAPE DESIGNER
4. FENCING-LANDSCAPE DESIGNER
5. OUTDOOR LIGHTING RELYING ON RENEWABLE ENERGY- ENERGY CONSULTANTS
6. NATIVE SHRUBS- LANDSCAPE DESIGNERS
7. ENERGY EFFICIENT, GLAZING- ARCHITECTS
8. ENERGY EFFICIENT SHADING DEVICES - ARCHITECTS
9. PEDESTRIANS, WALKWAYS AND UTILITY CORRIDORS- LANDSCAPE ARCHITECTS
10. PERGOLA SHADING HARD PAVED SURFACES- ARCHITECTS
11. SOLAR WATER HEATER- ENERGY CONSULTANTS
12. SOLAR PHOTOVOLTAIC- ENERGY CONSULTANTS.



Figure Cross section through a typical building highlighting selected green features

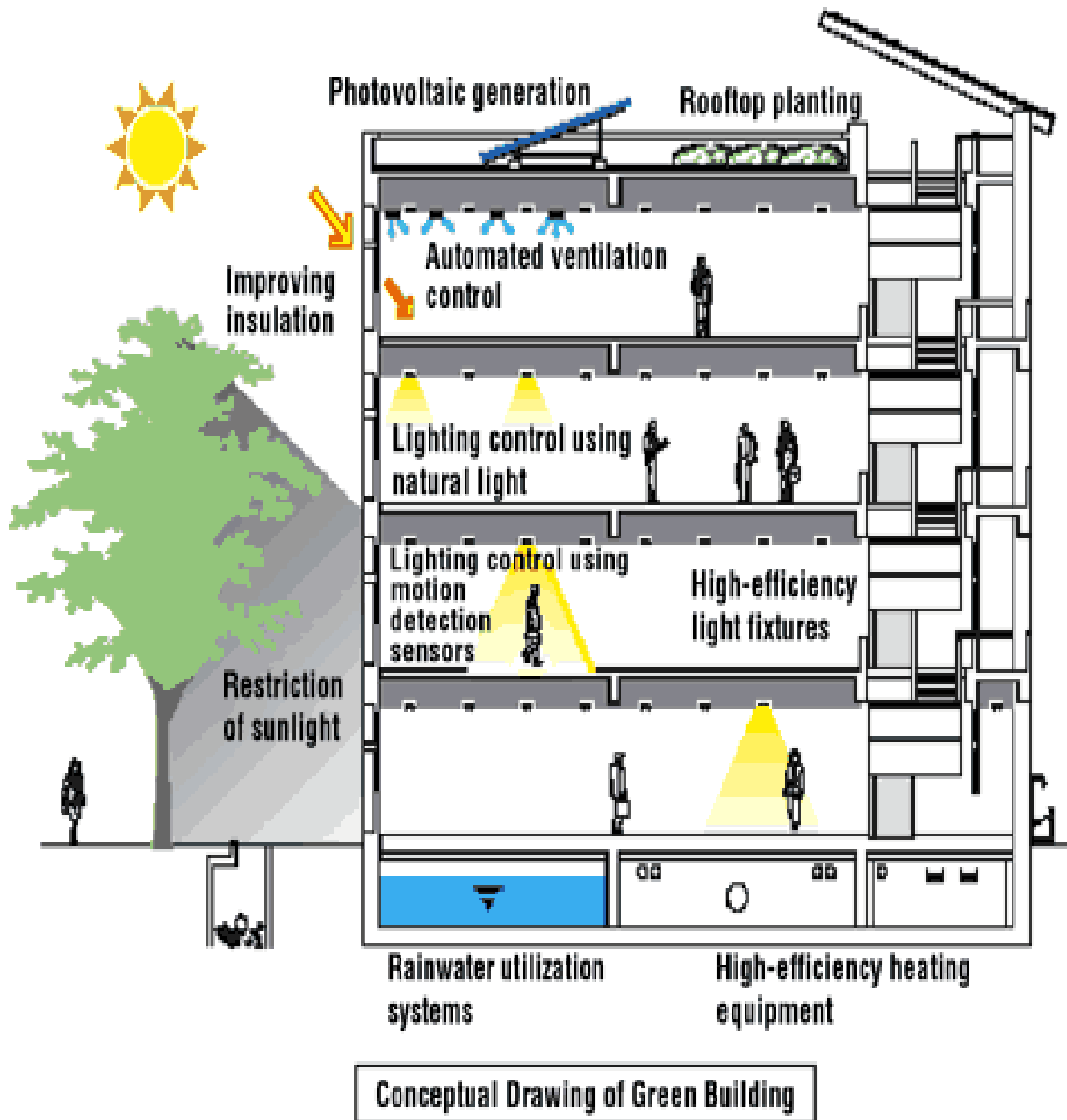
Source: Internet



LEGEND

EXPERTS INVOLVED

1. INSULATED WALL ,COMPLIANCE TO ECBC ARCHITECTS,INTERIOR DESIGNERS
2. INSULATED ROOF, COMPLIANCE TO ECBC ARCHITECTS, INTERIOR DESIGNERS
3. LOW VOC PAINTS ARCHITECTS, INTERIOR DESIGNERS
4. BEE STAR EFFICIENT ARTIFICIAL LIGHTING ELECTRICAL EXPERTS
5. BEE STAR LABELLED SPLIT AIR- CONDITIONING ELECTRICAL EXPERTS
6. DOOR FRAMES MADE USING RECYLED MATERIALS INTERIOR DESIGNING SPECIALIZED COMPANIES
7. FLOORING TILES MADE USING RECYLED MATERIALS INTERIOR DESIGNING SPECIALIZED COMPANIES
8. DUAL FLUSH WATER CLOSETS PLUMBING CONSULTANTS
9. LOW FLOW FAUCETS PLUMBING CONSULTANTS



Source: Internet

The Leadership in Energy and Environmental Design (LEED - INDIA) India Rating System is licensed by USGBC to the Indian Green Building Council to encourage and facilitate the development of sustainable buildings. Today a variety of LEED rated green building projects are coming up in the country – hotels, exhibition centers, hospitals, educational institutions, laboratories, IT parks, airports, government buildings and corporate offices. The LEED 2011 for India Green Building Rating System is a voluntary, consensus-based, market driven rating system based on existing, proven technology & processes. It evaluates environmental performance from a whole building perspective over a building's life cycle, providing a definitive standard for what constitutes a "green building". This rating system is based on accepted energy and environmental principles and strikes a balance between known established practices and emerging concepts. It is performance-oriented, wherein credits are earned for satisfying criteria addressing specific environmental impacts inherent in the design and construction. Different levels of green building certification are awarded based on the total credits earned. The system is designed to be comprehensive in scope, yet simple in application.

RATING OF GREEN BUILDING (LEED RATING)

The India Green Building Council (IGBC), a non-profit organization, has developed the leadership in energy and environment design (LEED) program on green building rating system. The LEED green building rating system of India deduced from USGBC and its being adopted in several countries, which includes USA, Japan, Australia, France, Canada India, etc.

The entire rating system comprises of 6 credits as under.

- Sustainable site
- Water efficiency
- Energy and atmosphere
- Materials and resources
- Indoor environment quality
- Innovation and design process

As per 1.0 version, There are 4 levels of certification, depending on the points as shown below.

Rating	New building
LEED certified	26-32
LEED certified Silver level	33-38
LEED certified Gold level	39-51
LEED certified Platinum level	52-69

Oil And Natural Gas Corporation Ltd. (ONGC) is India's flagship energy company, fully integrated across the hydrocarbon value chain and is ranked 1st among E&P companies of the world . ONGC has three office buildings as Green Buildings till date at Mumbai , Delhi and Dehradun.Out of which, it has constructed state of the art "Green Hills" to house its corporate office, the top management of ONGC located in Tel Bhawan campus at Dehradun .This building is registered as the prestigious 'platinum rating', awarded by the Indian Green Building Council (IGBC) as per the 1.0 version. For the new buildings, latest version 3.0 is in use in which Platinum rating is achieved when the building scores more than 80 points. ONGC Green Hills was registered to IGPC in 2009. At that time version 1.0 was in use. The entire team comprising of the architect, consultants, designers and project team has worked towards achieving the 'platinum rating' for the building. In the leadership of architect Hafeez Contractor and construction company Shapoorji Pallonji , this building has achieved 55 points out of 56 points, which they applied for.

SITE OF GREEN HILLS



EFFICIENCY AND AREA STATEMENT

Built up area=14500 Sq.m
 Usable area=12547 Sq.m
 Less than 20% circulation= usable area /built up area
 Efficiency 70 %

Source: Satellite pic

Green Hills, a 30 acres of undulating contoured site with larger central flat top area with steep and semi steep land drops along the periphery on three sides is located in Tel Bhawan, being Head Quarter of O.N.G.C. The main approach is from north, mainly used by VIPs and visitors. Rear gate is in the south used mainly by the employees.



Green Hills, at ONGC, Dehradun with Platinum rating Certificate

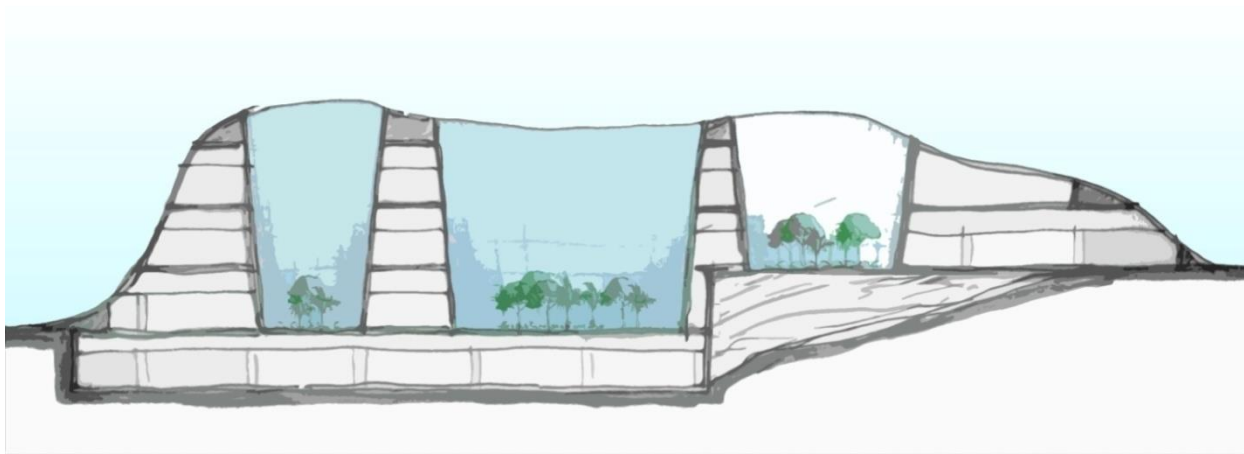
Source: Researcher

DETAILS OF SPACE PROVIDED AT GREEN HILLS

This is an office building with total Built up area , 14500 sqm and 12547 sq m as the usable area with 20% circulation. Designed by the famous architect, Hafeez Contractor, this Building is encased in the natural ground covered with turf grass, that acts as the natural green roofing with skylights acting as light wells. . To reduce the Urban Heat Island Effect, the project has 100% roof area with vegetation (excluding skylights area). Out of total roof area (8781 sq.m), the area of skylight is 1,031 sq.m and roof area covered with vegetation is 7,748.6 sq.m.

This whole building evolves its desired shape in an RCC Shell in vertical/horizontal plain to receive water proofing membranes of Polyurea in the form of spray. This outer surface is divided in to desired segments by placing / fixing brick works, to receive grass panels, creeper plants etc. to achieve green effect. Stepped terrace with water proofing, layer of earth, grass, creepers, sedum plants etc. are placed, wherever necessary as per roof slope.

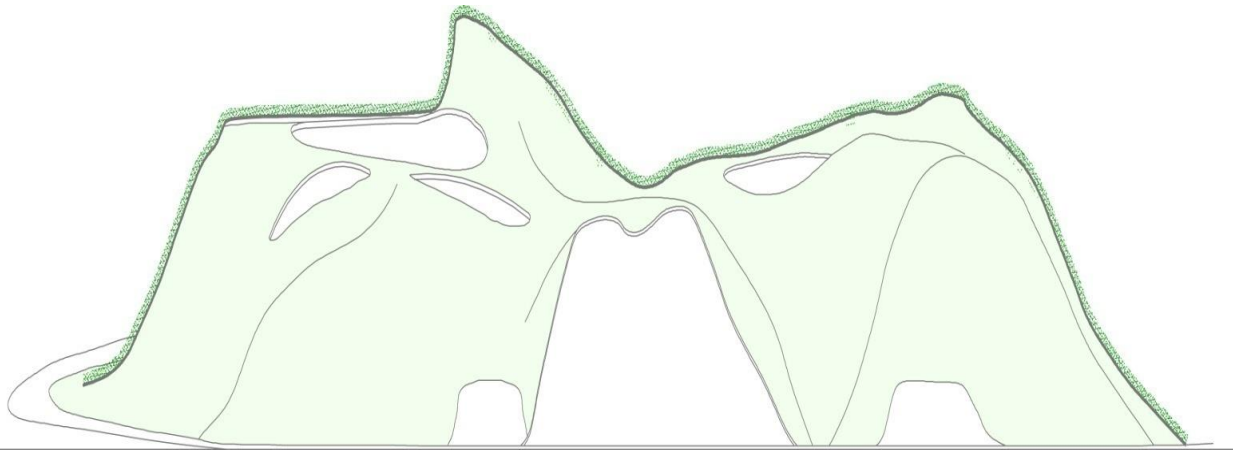
Schematic Section of the Building



Source: Researcher

BENEFITS OF NATURAL GREEN ROOFING

- Improved thermal performance.
- Reduced carbon dioxide level.
- Improved oxygen level.
- Contributes lowering urban temperature.
- Improved air quality.
- Reduced influence of night sky radiation on the roof.
- Encourages insect and bird life.
- High feel good factor for owner and occupants.



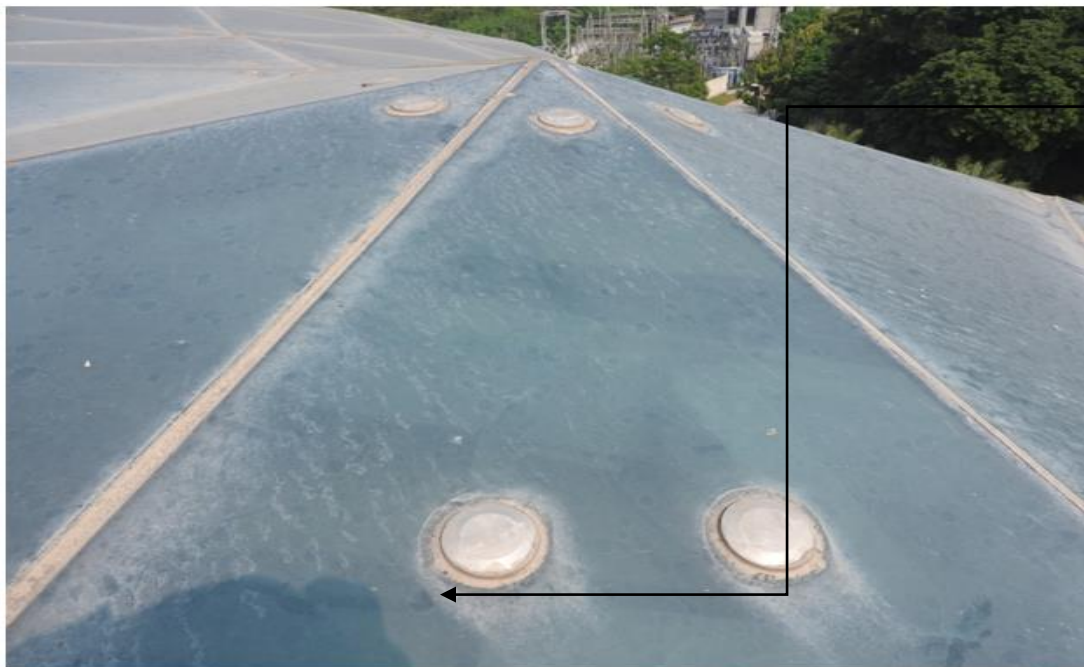
Schematic Elevation of the Building

Source: Researcher

IMPORTANCE OF LIGHT WELLS

The light wells are considered as the lungs of the living roof. These breath day light in to the various levels of office floors. There are 11 skylights in total which are having double layer 14 mm thick glasses. One is 6mm thick, the other as 8mm thick, with a rubber layer in between. Glass used in skylights are specially designed as per the U-Value and shading coefficient. They are anchored with spider systems, either 6 legged or 8 legged.

At the lower most level they develop up as a courtyards or spill out the areas for both, the food courtyard and the office floors.



14 MM THICK
SKYLIGHT GLASS
ANCHORED WITH
THE SPIDER SYSTEM

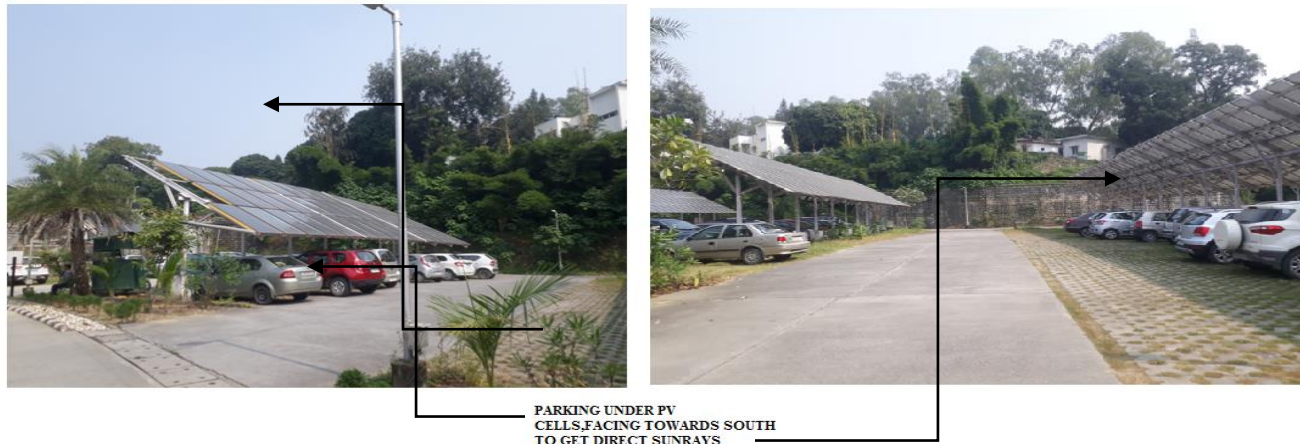
Skylight glass fixing

Source: Researcher

Parking Capacity

64 parking spaces are provided in the basement and 205 spaces on surface out of which 99 car parks are provided under PV cells shade. These PV cells help in generating hot water in the building and 8% of electricity

is generated by PV Cells.

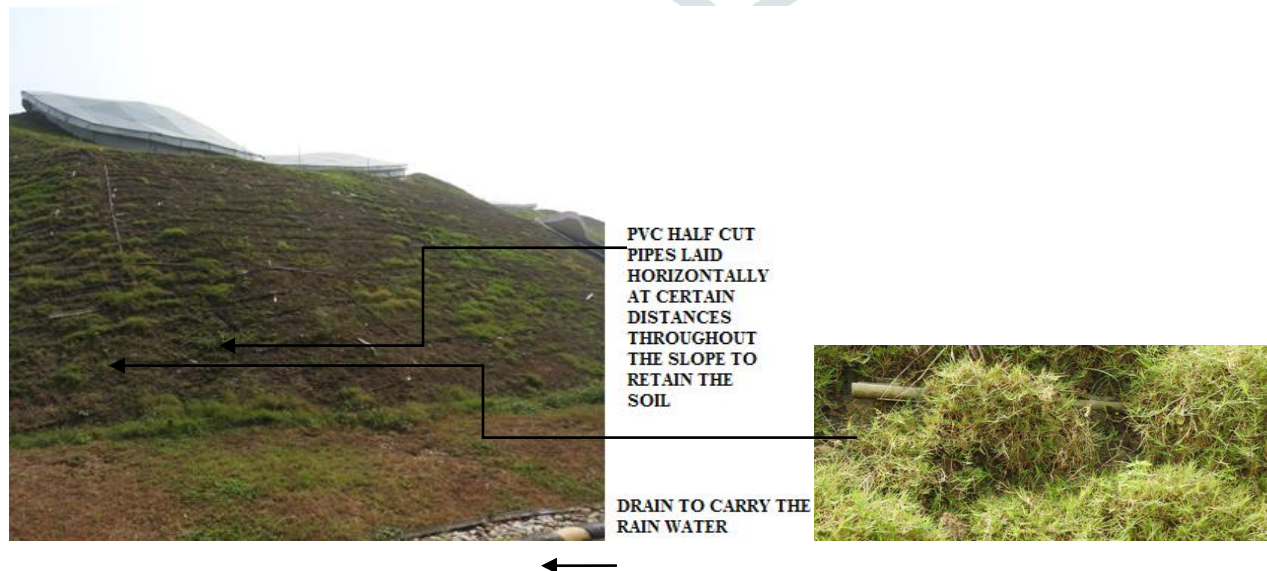


Parking under Solar Panels

Source: Researcher

Landscaping

Hill Greens has reduced Site disturbance, protected and restored the habitat on Greenfields sites. Landscape in the project includes only native and adaptive species. Further, the project has restored more than 50% of site area (excluding building footprint) and also provided extensive vegetation on entire roof area of the building (excluding skylights area). Out of the total open area on-site (14,958.06 sq.m), 7,600 sq.m is vegetated open space which caters to more than 50%. Also, total vegetated roof area is 7,748 sq.m. Green/ vegetated area has conserved throughout the life of building. A landscape plan indicates that the building footprint is 8,781 sq.m and area provided with vegetation is 15,349 sq.m, which is a combination of vegetated area on-site (7,600 sq.m) and vegetated roof area (7,749 sq.m). The vegetated open space area provided on the site is 14,958 sq.m, which is more than building footprint. PVC half cut pipes are spread in a horizontal way throughout the slope to retain the soil. Roof gardening at such a big scale has happened for the first time in India.



PVC half cut pipes to retain soil

Source: Researcher

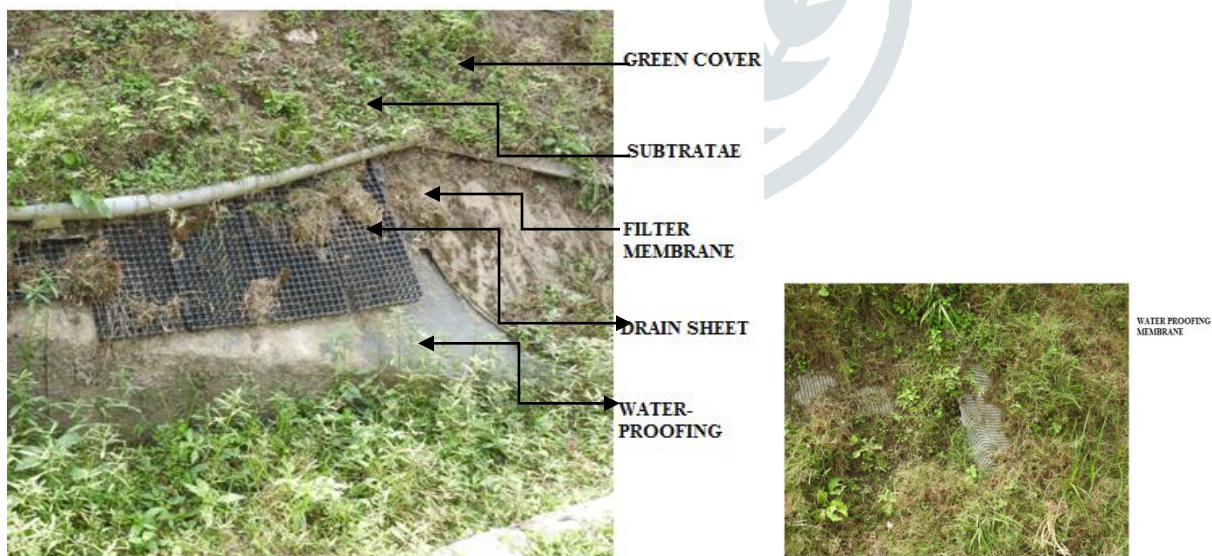


Landscaping inside and outside building

Source: Researcher

WATER PROOFING

Green Hills has 100% green roof excluding skylights. The most challenging part was to do the waterproofing of the whole building. Waterproofing was needed which had low shrinkage, excellent mechanical properties, good direct adhesion on bituminous roofing membrane, long life cycle, seamless and jointless lining and high abrasion resistance. For that, a company from Pune, was hired for this task which had its own patent materials to accomplish this work. After cleaning with high pressure water jets, Polyurea coating was sprayed over the 150mm th.RCC Slab. Later the root resistant foil is spread over the whole roof and Hydrophylic foam is added which retains the moisture. Eggshell slabs, which are easily cut are installed. Substratae spraying makes the base



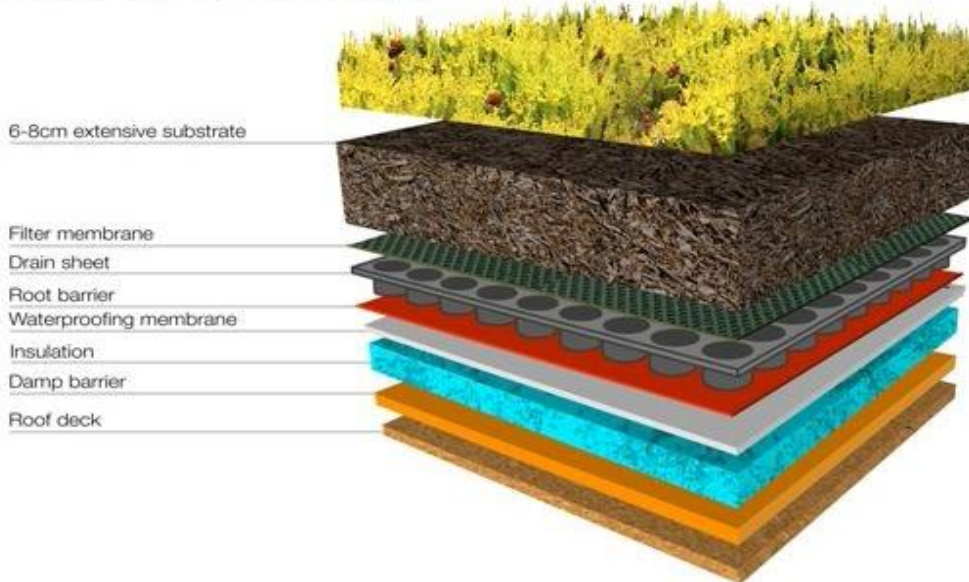
for grasses.

Water proofing Detail at site

Source: Researcher

Extensive Green Roof

Weight 80-110kg/m² / slope of min. 3 degrees



Schematic Detail of Water proofing

Source: Internet

STORM WATER ARRANGEMENT

A storm water management plan which results in 30.6% decrease in the rate & quantity of storm water runoff has been implemented by providing 2 rainwater harvesting pits. The total rain water harvested on-site is 195.26 KLD. Post-development Storm water runoff is 30.6% of the pre-development run-off. Water Efficiency in Air-conditioning System, shows 50% Reduction. The potable water demand for air-conditioning make-up is reduced by 50% over conventional means by recycling grey water generated on site through STP and using the treated water for cooling tower make-up.

Irrigation is done by Sprinkler system. Sprinklers are added at regular intervals all over the green roof o High density Polythylene pipes (HDPE Pipes) . Roof top water and road chamber water , both are taken through drains, at the base of the slope and sides of roads to Rain water Harvesting Systems. Water flows through gravity ,without any mechanical means.



HIGH DENSITY POLYTHYLENE PIPES (HDPE PIPES) FOR SPRINKLER SYSTEM.

HDPE Pipes for sprinkler system

Source: Researcher



Drains taking water to Rain water harvesting through gravity Source: Researcher

RENEWABLE ENERGY

The renewable energy is generated on-site as 7% of building's total annual energy cost. The project has installed 35 kW and 73 kW solar power generation units which generate more than 7.5% of total energy requirement of the building. The total annual energy consumption in the project is 1,433,945.933 kWh. The total energy generated from Solar PV is 150, installed in the parking area 468.89 kWh, which is 10.49% of the building's total energy use and energy cost.

CONSTRUCTION WASTE MANAGEMENT

The submitted LEED India Template declares that the project has diverted more than 75% construction waste from landfills. The project is able to divert 97% of construction waste from going to landfill. Few of the materials diverted from going to landfill, include broken stone, brick waste, concrete mix waste, wood scrap, MS pipes, steel scrap etc.

INDOOR ENVIRONMENTAL QUALITY

The project has chosen mechanical ventilation system where the conditioned space is divided into different zones with separate air handling units provided for each zone. Low Emitting Materials like Paints which have a low VOC content are used.

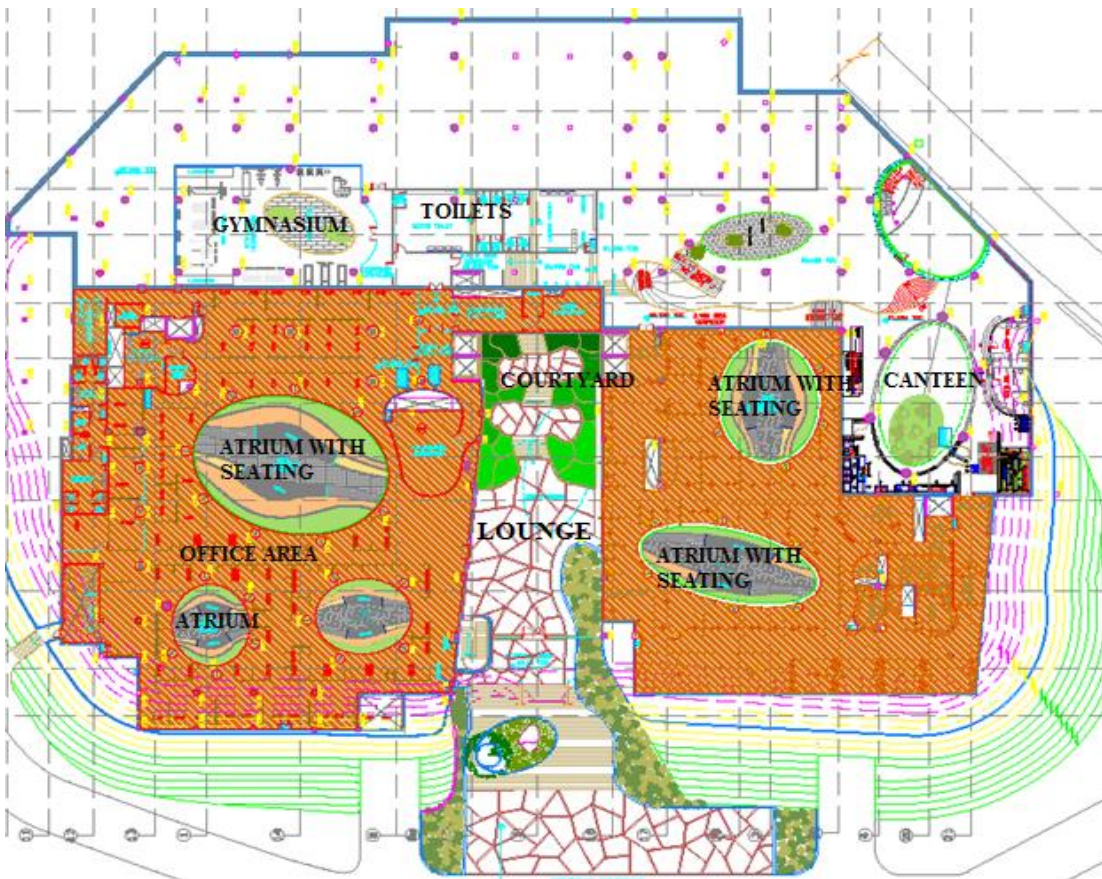
WATER USE REDUCTION

The project has 40.55% of the water savings by installing water efficient fixtures.

MATERIALS USED

Locally extracted materials used in the project include AAC block, sand, stone dust, aggregates, bricks, various types of stones, concrete grass paver blocks, concrete cement paver blocks, plywood, gypsum board and gypsum plaster.

GROUND FLOOR PLAN



Entrance

Source: Researcher



Entrance

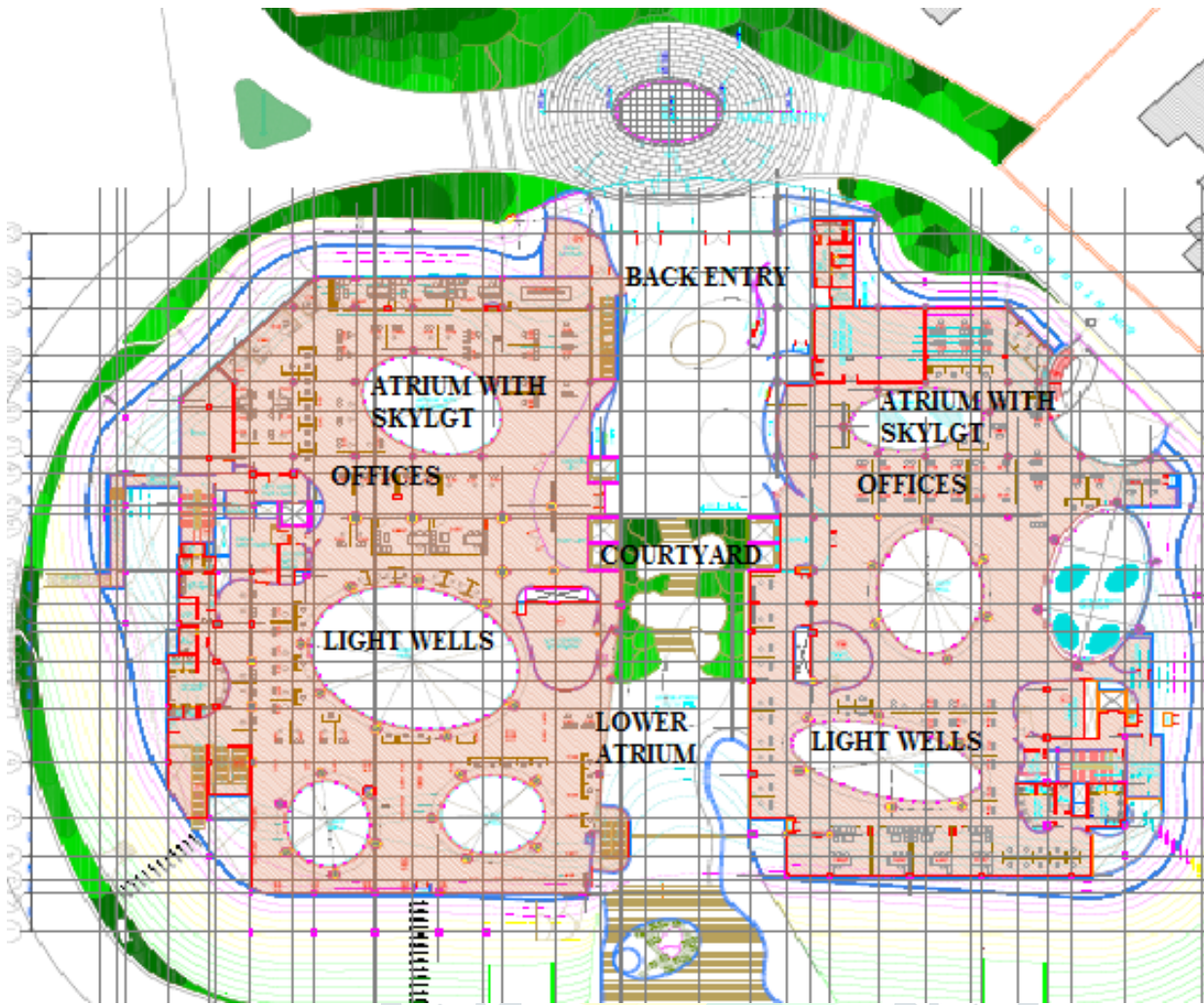
Source: Researcher



GROUND FLOOR

Source: Researcher

1ST LEVEL PLAN



LOWER LEVEL

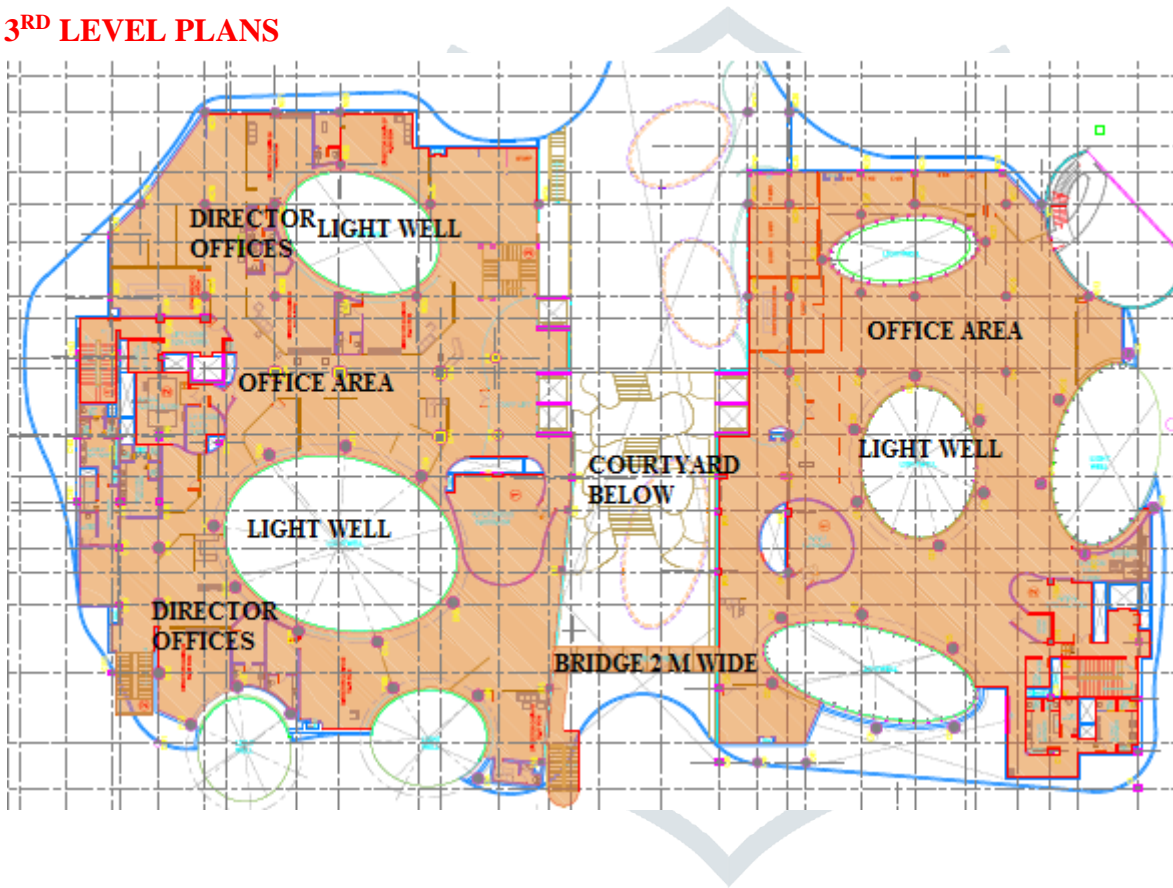




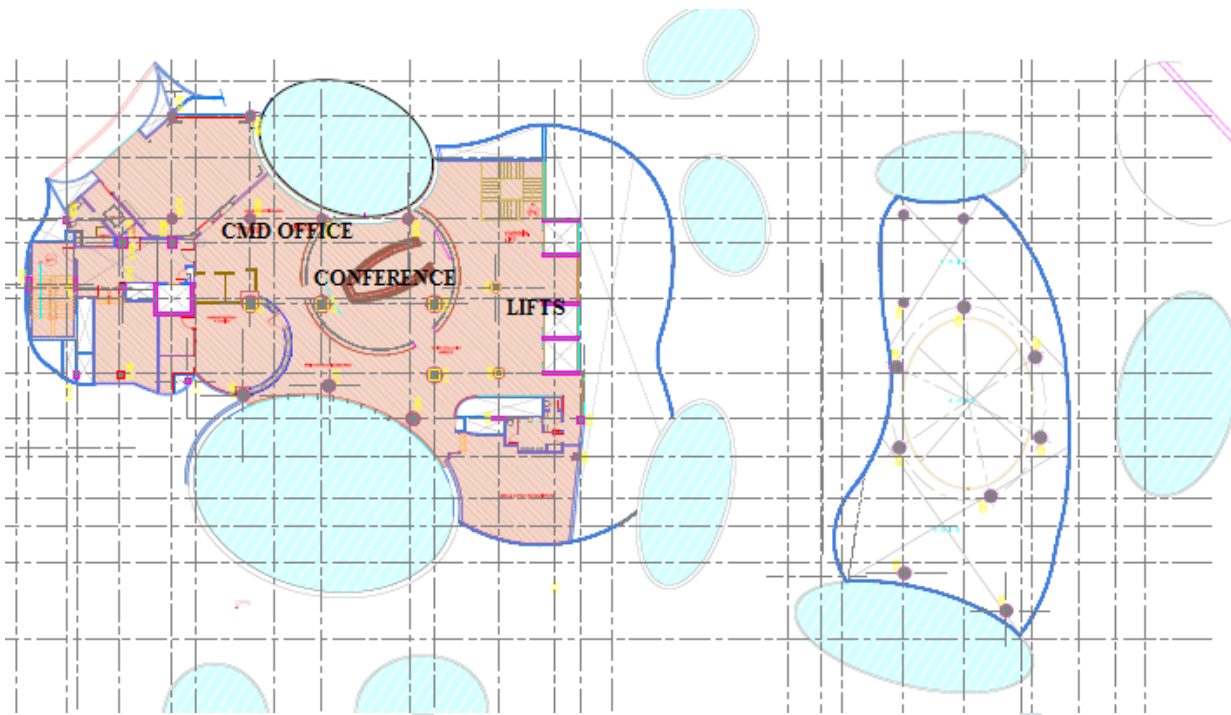
Lower Level Landscaping

Source: Researcher

3RD LEVEL PLANS



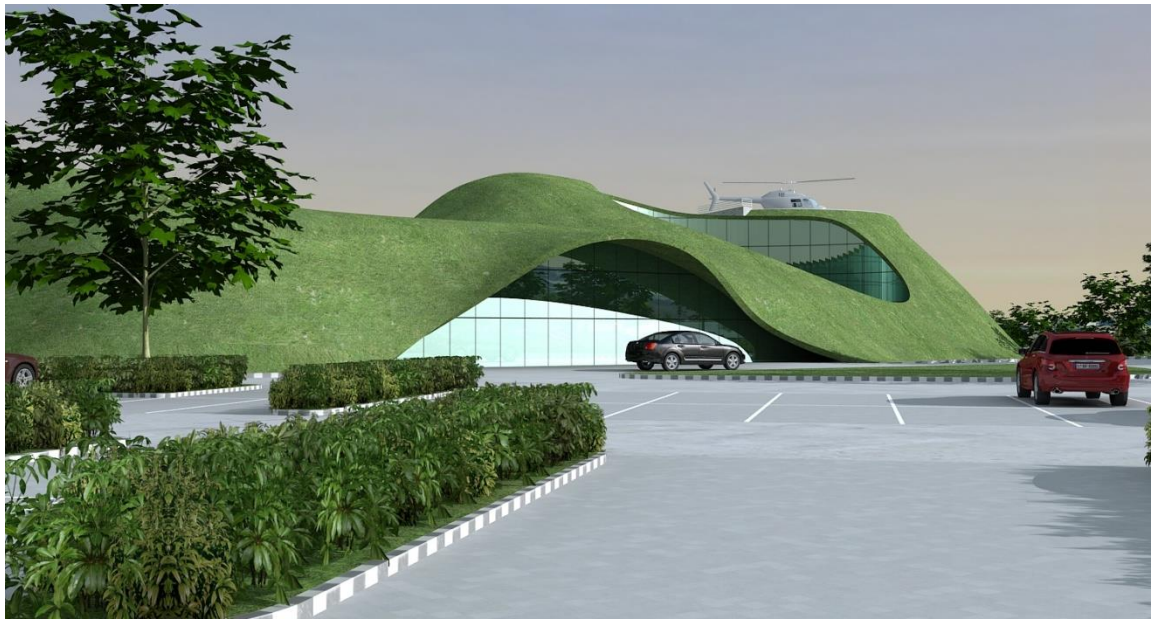
4TH LEVEL PLAN



4th Level Landscaping

Source: Researcher

DIFFERENT VIEWS OF GREEN HILLS



MYTH VERSUS REALITY

Green Buildings are Costly –

Reality

The most criticized issue about constructing environmentally friendly buildings is the price. Photo-Voltaics, new appliances, and modern technologies tend to cost more money. Most green buildings cost a premium of <2%, but yield 10 times as much over the entire life of the building. The savings in money come from more efficient use of utilities which result in decreased energy bills.

Building	Year awarded	Built-in Area (Sqft)	Rating Achieved	% increase in cost	Payback (Yrs)
CII-Godrej GBC, Hyderabad	2003	20,000	Platinum	18 %	7 years
ITC Green Centre, Gurgaon	2004	1,70,000	Platinum	15 %	6 years
Wipro, Gurgaon	2005	1,75,000	Platinum	8 %	5 years
Recently Rated Green Buildings					
Technopolis, Kolkata	2006	72,000	Gold	6%	3 years
Spectral Services Consultants Office, Noida	2007	15,000	Platinum	8%	4 years
HITAM, Hyderabad	2007	78,000	Silver	2%	3 years

Source: Internet

Green Buildings take more time-

Reality

Design parameters are frozen in one go for Green Buildings. Only little additional efforts are required for completing the task. Only thing is, one has to be very precise before getting into constructional details.

Green buildings require air-conditioning-

Reality

Non air –conditioned building can also be a Green Building. Suited for Indian buildings eg. IGP Office at Gulbarga has Wind Tower Cooling and has rated Gold rated.

Green building practices aim to reduce the environmental impact of buildings. Buildings account for a large amount of land use, energy and water consumption, and air and atmosphere alteration. Considering the statistics, reducing the amount of natural resources buildings consume and the amount of pollution given off is seen as crucial for future sustainability. The environmental impact of buildings is often underestimated, while the perceived costs of green buildings are overestimated. A recent survey by the World Business Council for Sustainable Development finds that green costs are overestimated by 300 percent, as key players in real estate and construction estimate the additional cost at 17 percent above conventional construction, more than triple the true average cost difference of about 5 percent.

Conclusion-

For ages, we have been trying to invent technologies in science and architecture to address the ill effects of modern energy. While such a search is inexorable, I propose to combine the solutions worked out by our ancestors with technological revolution to achieve a sustainable architecture. This can result to a higher efficient building rather than if only modern technology is used. Our traditional principles always respected the environment with the climate responsive designs, use of local materials, water harvesting systems by using architectural elements like roof terraces, courtyards, clustered planning, roof terraces, courtyards, jaalis, wind towers, etc. The challenge for today is to restore these ancient methods with modern technological innovations in the form of a Green Building.

