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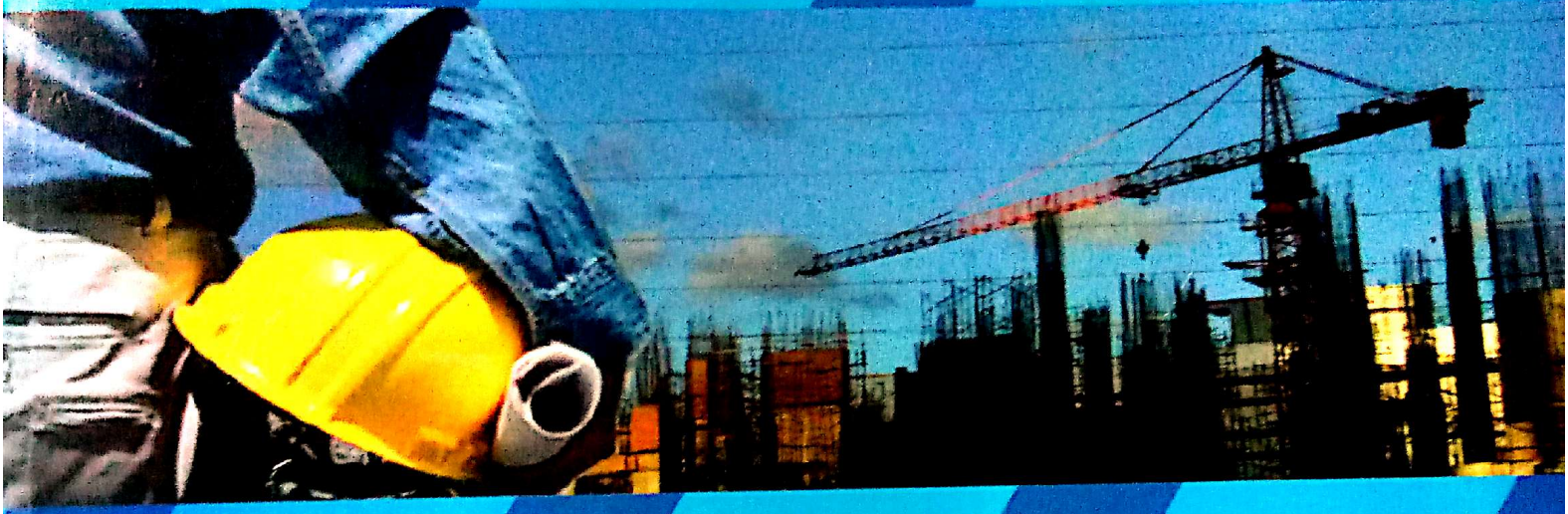

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ANALYSIS ON GREEN BUILDINGS (CASE STUDY: CII SOHRABJI GBC, HYDERABAD, INDIA)

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Abstract: *The idea of green building has made an enormous significance in a creating nation like INDIA. The hypothesis suggests of minimizing the wastage and the expense of development. With expansion in urbanization the normal assets were utilized as a part of ill-advised ways which drives us towards the usage of green structures and the idea helps in making ideal utilization of regular assets. The green building is an eco-friendly segment, since it depends on the essential tenet - "REDUCE, REUSE and RECYCLE". In the long run, the green structures manage the cost of an abnormal state of financial and building execution, which drives us to the advancement of future era. The point of a green building configuration is to minimize the interest on non-renewable assets, amplify the use effectiveness of these assets when being used and boost reduce, reusing and usage of renewable assets. It amplifies the utilization of effective building materials and development hones; enhances the utilization of local sources and sinks by bio-climatic design; utilizes least vitality to power itself; utilizes productive gear to meet its lighting, aerating; cooling and different needs; boosts the utilization of renewable wellsprings of vitality; uses proficient waste and water administration hones; gives agreeable and hygienic indoor working conditions. With regards to the expression "Green Buildings," we may simply characterize it as an extraordinary sort of working without knowing the subtle elements and foundation behind it. Really, Green Buildings comprise of a wide range of sorts of material and gear. Their appearances additionally vary from other typical structures. Green structures regularly incorporate measures to lessen vitality use. To expand the productivity of the building envelope (boundary amongst molded and unconditioned space), they may utilize high-proficiency windows and protection in walls, roofs, and floors.*

Author keywords: *Green Building; Resource efficiency; Energy efficiency; Waste reduction; Passive design; CII Sohrabji; GBC*

Introduction

These days, people give careful consideration to ecological security, in this manner build up another pattern called Green Buildings. It's not about the shading green, but rather has something to do with another structural idea. The "Green Building" is an interdisciplinary subject, where the green building idea incorporates a large number of components, segments and methodology which veer to a few subtopics that entwined to frame the green building idea. For the most part, the green building is thought to be a natural segment, as the green building materials are produced from neighborhood eco-sources, i.e. ecologically friendly materials, which are then used to make an eco-development subject to an eco-plan that give a solid environment based on the social and compositional legacy in development while guaranteeing protection of characteristic assets. This ensures dismantling the building parts and materials, after a decided building lifetime, to ecologically well disposed materials that can be either re-utilized or recycled.

Green building (otherwise called green development or supportable building) alludes to

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both a structure and the utilizing of procedures that are earth capable and asset proficient all through a building's life-cycle: from referring to outline, development, operation, upkeep, redesign, and destruction. At the end of the day, green building outline includes finding the harmony amongst homebuilding and the supportable environment. This requires close collaboration of the configuration group; the draftsmen, the specialists, and the customer at all anticipate stages.

Although new advances are always being produced to supplement current practices in making greener structures, the regular goal of green structures is to decrease the general effect of the assembled environment on human wellbeing and the common habitat by:

- Efficiently utilizing energy, water, and different assets
- Protecting tenant wellbeing and enhancing representative profitability
- Reducing waste, contamination and environmental degradation.

The expression "Green" alludes to naturally, neighborly practices from building configuration to the finishing decisions. It additionally hopeful person and Economic vitality use, water utilize, and storm water and waste water reuse.

A Green building is that building which is developed at an all around arranged area with legitimate configuration and reasonable materials fitted and painted with eco agreeable materials. The building ought to provide for its inhabitants solid and agreeable environment in all atmospheres. It stays cool in summer, warm in winter, inside completely shielded from downpour, gives normal contamination free air and light through entryways, windows and ventilators with no simulated means. For specific prerequisites it has sun based, wind power and eco friendly electrical, mechanical and so on gadgets. The expression "Green Building" applies to items, as well as to development systems, building outline and introduction, finishing, building operations, support, and the sky is the limit from there. The less effect a building has on human wellbeing and the earth, the more green it is.

Related Literature

A study done by Boyd and Kimmet (2006), took a gander at the Triple Bottom Line (TBL) way to deal with the budgetary execution of speculation properties, concentrating particularly on ecological and social attributes of green structures. The likely effect of improved natural qualities on venture sort property is appeared in Figure 1.

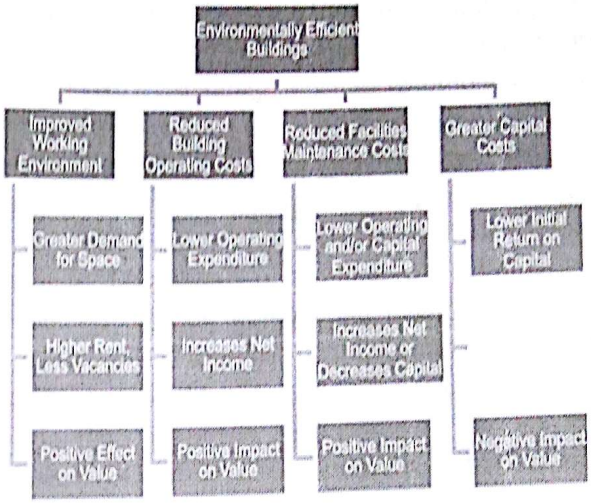

Figure 1: Value Impact of Environmentally Efficient Buildings

The figure shows four expected outcomes from greater environmental efficiency, i.e. improved working environment, reduced building operating costs, reduced facilities maintenance (FM) costs and increased capital costs. All characteristics, with exception to the latter had positive impacts on the capital value of property.

A study started by the Building Construction Authority (BCA) and the Department of Real Estate, National University of Singapore (NUS) in 2011 examined 23 business properties that were refurnished. Key components considered incorporated the residency, period of property, area, size, Green Mark honor rating and year of recompense and vitality utilization figures (prior and then afterward retrofit) and capital use for the

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retrofit venture. The study inferred that retrofitting can prompt an expansion in the property estimation of around 2%, with a normal expected investment funds in working costs of 10%.

Research has also been done primarily by Lorenz and Lutzkendorf, Sayce et al., Boyd and Kimmet in proposing to modify valuation theory and methodologies to incorporate sustainability features in valuation. Generally they proposed that sustainability issues would affect major risk factors in computing the asset value. Thus, valuers can attach a risk premium to each of these factors or group the risk factors to adjust other parameters used in traditional valuation methods.

As compared to conventional projects, green projects tend to cost more to construct. Some green materials cost significantly more than their conventional counterparts, compressed wheat board costs about ten times more than ordinary plywood as stated by Shristi and Singh. Green materials costs from 3 to 4% more than conventional construction materials and also conclude that higher costs are due to design complexity and the modeling costs needed to integrate green practices into projects which was proposed by Zhang et al. Hwang and Tan proposed that higher costs are associated with green materials and also by using green construction technologies. According to an estimate by Tagaza and Wilson, capital costs for green projects range from 1 to 25% higher than conventional projects.

Peter et al. included that a green building is a result of an outline logic which concentrates on expanding the effectiveness of asset utilize. Kamana and Escultura characterized "supportable building" or "green working" as a result of an outline which concentrates on expanding the proficiency of asset utilize - vitality, water and materials – while decreasing building impacts on human wellbeing and the earth amid the building's lifecycle, through better area, plan, development, operation, upkeep and evacuation.

Peng and Sui Pheng expressed that green structures, frequently characterized as those including regular ventilation capacities, i.e. low-vitality or free-running structures are presently at the bleeding edge of building examination and environmental change alleviation situations.

Chatterjee characterized the "Green building hone" as a procedure to make structures and framework in a manner that minimize the utilization of assets, decrease hurtful impacts on the nature, and make better situations for tenants. Xing et al. expressed that structures represent half of vitality utilizations in European nations and vitality request in building keeps on becoming around the world.

Horman et al. have exhibited that procedure assumes a key part in effectively conveying a superior green office inside spending plan and on time. The hypothesis supporting elite venture conveyance is that decreased procedure waste can upgrade both reasonable results and the business case for maintainability.

Tagaza and Wilson expressed that, Random checks and on location visits by venture chiefs are typically required to guarantee that economical practices that are executed nearby conditions, this is basic since specialists may have a tendency to forego tedious feasible practices when there are time weights to finish a venture.

Essential Concepts of Green Buildings

A green building is one whose development and lifetime of operation guarantees the most beneficial conceivable environment while speaking to the most productive and slightest problematic utilization of land, water, vitality, and different assets. Makers, developers, originators, and buyers are making a growing business sector for lodging and home items that dirty less and are more asset proficient. By utilizing green items and practices, our homes can be solid and agreeable additionally earth well disposed and cost proficient. Here are 10 rules with a couple of case to consider for everyone.

1. Create outline gets ready for the building itself.
2. Situate and outline working to site needs. atmosphere, and neighborhood conditions.

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3. Augment the utilization of normal sunlight.
4. Research building materials.
5. Reuse existing materials, use less materials, and use building materials that are thought to be naturally cordial.
6. Plan for solid indoor air quality.
7. Set high lighting-effectiveness measures.
8. Select machines that are vitality productive and save money on water use.
9. Plan for simplicity of upkeep and utilization of earth neighborly cleaning items.
10. Keep up basic and building frameworks for most extreme vitality and ecological adequacy.

Principles of Green Architecture and Sustainability

Passive features shape an irreplaceable piece of Green Building Design that is the most essential and imperative stride to be accomplished with a specific end goal to make a reasonable and Green environment. Passive components of a Green Building are the configuration includes that are to be fused in a building with the goal that it requires utilization of lesser energy assets by the clients of the building furthermore keep up an agreeable way of life.

Dynamic elements of Green Architecture infer on the utilization of gear that chips away at Renewable assets and help in the protection of regular and non-renewable assets which includes:

1. Site and its environment
2. Energy Efficiency
3. Water Efficiency
4. Material Efficiency and Waste Reduction
5. Indoor Air Quality

Siting and Structural Design Efficiency:

For a green building, it begins with appropriate site choice as the decision of area can influence an extensive variety of natural component such as security, openness and vitality utilization, both immediate and roundabout. Deliberately arranging minimizes storm water overflow, lessens dangers of disintegration and augments open space and secures existing territories. The building can be intended to preserve vitality by exploiting the characteristic site components.

Energy Efficiency and Environmental Protection:

Energy preservation and ecological insurance are fundamental to accomplish manageable advancement. One of the fundamental points of a green building is to have slightest effect on the earth through supportable configuration, energy proficiency and renewable energy. Several theories portrays how structures can be intended to minimize their reliance on fossil types of energy, lower their working expenses, make more beneficial environment for their tenants and add to the battle against environmental change, without essentially causing high aggregate expense.

Water Efficiency:

Diminishing water utilization and ensuring water quality are key goals in supportable building. One basic issue of water utilization is that in numerous ranges, the requests on the supplying aquifer water treatment and warming enhances both water quality and vitality effectiveness while lessening the measure of water available for use.

Material Efficiency and Waste Reduction:

Building development is resource intensive. The building area is in charge of more than 33% of worldwide asset utilization every year. The assembling of building materials devours around 10 percent of the worldwide vitality supply. In green structures, there is an inclination for building materials that are fewer assets comprehensive, reused, all things considered, and are non-lethal. Because of the more prominent mindfulness about the importance of green creation materials, the business sector is experiencing development and quick change.

Indoor Air Quality (IAQ):

The Indoor Environmental Quality (IEQ) class in

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LEED benchmarks, is one of the five natural classifications, was made to give solace, prosperity, and efficiency of inhabitants. The LEED IEQ classification addresses outline and development rules particularly: indoor air quality (IAQ), warm quality, and lighting quality.

Indoor Air Quality tries to decrease unstable natural mixes or VOCs, and other air debasements. Structures depend on a legitimately planned ventilation framework (inactively/normally or mechanically-controlled) to give sufficient ventilation of cleaner air from open air or re-circled, sifted air and additionally disconnected operations from different inhabitances.

CASE STUDY:

Table 1: Details of CII-Sohrabji Godrej Green Business Centre

Project	CII - Sohrabji Godrej Green Business Centre (CII - Godrej GBC)
Building type	Corporate
Architect	Karan Grover & Associates
Investor / Owner	Confederation of Indian Industry (CII)
Project built date	Inaugurated by Dr A P J Abdul Kalam on July 14, 2004.
Location	CII - Sohrabji Godrej Green Business Centre, Survey # 64, Kothaguda Post, near HITEC, Ranga Reddy District, Hyderabad
Purpose	Sohrabji Godrej Green Business Centre in Hyderabad. It's a commercial building which consists of office buildings, research labs & conference rooms.
Size	4.5 acres (total site area) 1858 m^2 (total built up area) 1115 m^2 (total air conditions area)
Rating	LEED rating – 56 credits The First LEED Platinum Rated Building in India
Designers	Architect : Karan Grover & Associates Energy consultants: TATA Energy Research Institute Structural consultants : Comten consultants Landscape architect : Arati Chari & Associates
Increase in cost	18 %
Payback period	7 Years

Location:

CII-Sohrabji Godrej Green Business Centre (CII-Godrej GBC), Survey # 64, Kothaguda Post, Ranga Reddy District, Hyderabad.

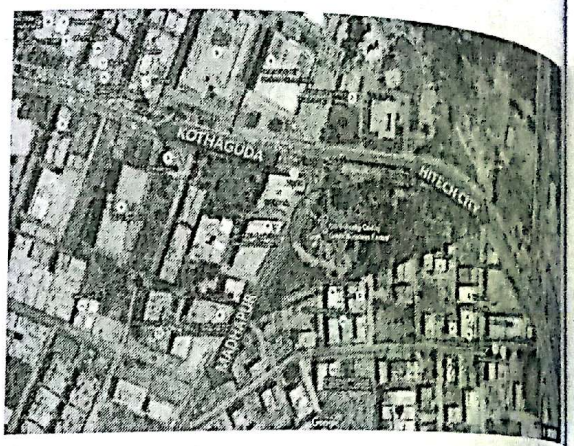

Figure 2: Location map of CII - Sohrabji Godrej GBC

About CII-Godrej GBC:

CII-Sohrabji Godrej Green Business Center (CII-Godrej GBC) was built up in the year 2004, as CII's Developmental Institute on Green Practices and Businesses went for offering world class admonitory administrations on protection of common assets. The Green Business Center in Hyderabad is housed in one of the greenest structures on the planet and through Indian Green Building Council (IGBC) is initiating the Green Building development in the nation. The Services of Green Business Center incorporate Energy Management, Green Building, Green Companies, Renewable Energy Green House Gas (GHG) innovation, Green Product Certification, Waste Management and Cleaner Production Process. CII-Godrej GBC works intimately with the partners in encouraging India rise as one of the worldwide pioneers in Green Business by the year 2022.

Green Building Tour:

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Figure 3 represents the layout of CII Godrej GBC which includes:

- ✓ Central courtyard.
- ✓ Roof garden - Protects heat penetration, cuts
- ✓ Down heat-island effect
- ✓ High performance glazing to bring in natural
- ✓ Light while minimizing heat ingress.
- ✓ Usage of light glazing and vision glazing.
- ✓ Jalis (Perforated) wall for bringing in natural light as well as ventilation.
- ✓ Energy saving system.

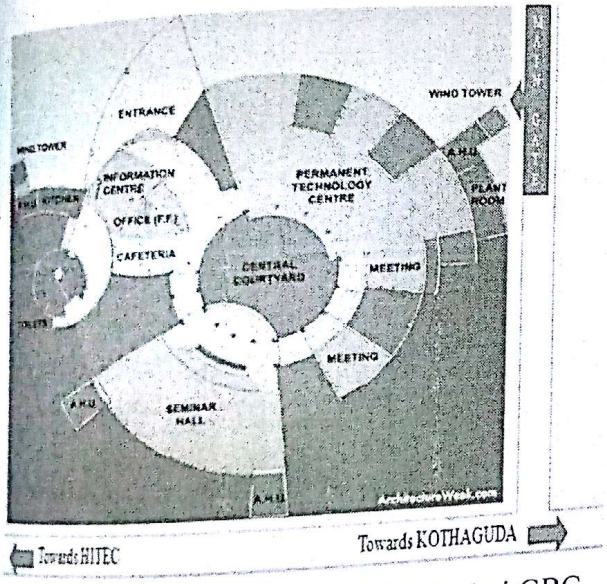

Figure 3: Typical Layout plan of CII Godrej GBC

Green Features incorporated in CII Building Project:

- ✓ Bio-climatic Architecture.
- ✓ Minimize damage during construction (cost efficiency)
- ✓ Occupancy to the natural elements of water flow, air quality, vegetation, and topography.
- ✓ Fenestration maximized on the north orientation
- ✓ Rain water harvesting.
- ✓ Large vegetative open spaces.
- ✓ Swales for storm water collection.
- ✓ Facility for charging electric automobiles for building occupants.
- ✓ Open spaces in the site exceed the local requirements by more than 25%.
- ✓ All paved parking and pathways constructed with pervious materials.

1. Energy Efficiency

Apparently, the greatest element of the CII-Godrej GBC building is its vitality productivity. The building gloats of lighting vitality investment funds of 88 percent contrasted with an electrically light working of a similar size. The building design guarantees that 90 percent of the spaces have sunshine get to and perspectives to the outside. In a few regions jalis or cross section dividers, are utilized to forestall glare and warmth pick up while guaranteeing sufficient day lighting and perspectives.

Rooftop Garden:

- The green rooftop helps with expanding the life expectancy of the rooftop and lessening the warmth island impact, assimilates warm and transmitting it into the working as appeared in Figure 4.
- Vegetated rooftops cover 55-60% of the building's rooftops, and the rest of the segment of the rooftop is secured by sun powered photograph voltaic with a 24 KW limit.

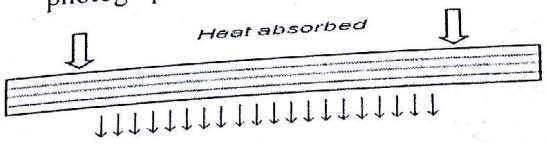

Figure 4: Roof covering pattern of CII Godrej GBC

Courtyards:

The Courtyards go about as "light wells," enlightening adjoining work territories as appeared in Figure 5. At the point when light is not adequate, sensors trigger the organization of effective electric lights. Dimmers naturally control the enlightenment levels, killing the lights when they're pointless.

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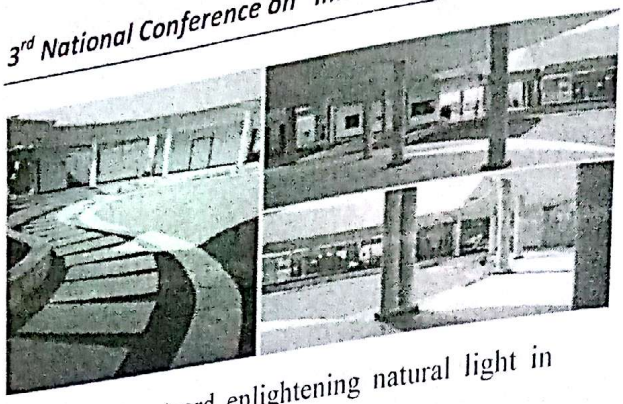


Figure 5: Courtyard enlightening natural light in CII Godrej GBC

Natural light:

Common light redirection frameworks can coordinate light profound into the room and guarantee better normal lighting arrangements as appeared in Figure 6.

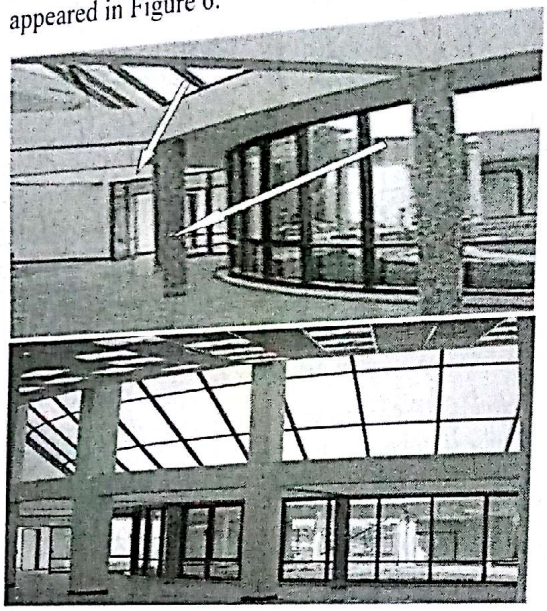
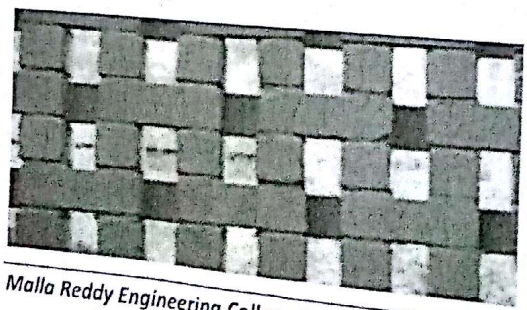


Figure 6: Glazing systems enlightening natural light in CII GBC

Utilization of Traditional Jalli:

Jallis or Lattice dividers are utilized to avert glare and warmth pick up while guaranteeing sufficient day lighting and perspectives as appeared in Figure 7. The jalli, utilized as a part of numerous memorable structures.



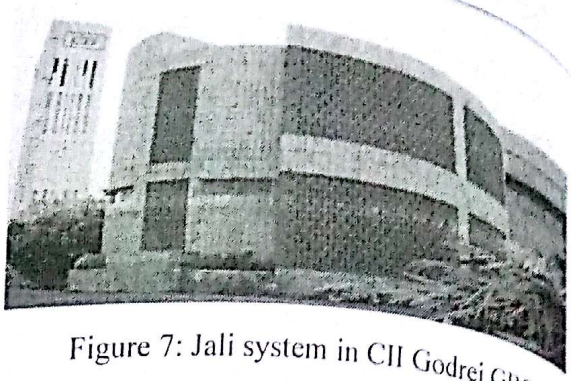


Figure 7: Jali system in CII Godrej GBC

Energy Conservation Calculations

Table 2: Load consumption data of CII Godrej GBC (if it was a Green Building)

Items	Wattage	No's	Approx. working hrs/day	Energy Consumption (Wh/day)
CFL lamps	15	36	2	1,080
Fluorescent tube	35	104	3	10,920
Fan	60	35	3	6,300
Computer	150	15	4	9,000
Printer	70	15	0.5	525
T.V	250	2	5	2,500
Water cooler	1,000	2	5	10,000
Motor	1,100	1	2	2,200

Total Energy consumptions per day = 1080 + 10920 + 6300 + 9000 + 525 + 2500 + 10000 + 2200 = 42,525 Wh/day = 42.525 KWh/day

Monthly energy consumptions (KWh) = Energy consumptions/day * No. of working days = 42.525 * 24 = 1,020.6 KWh

Total electricity bill per month in Rs:

Fixed charge = 2400 Rs

Energy charge = 1020.6 × 4.9 = 5000.94 Rs

Fuel charge = 1020.6 × 1.24 = 1265.544 Rs

ISBN: 978 93 83038 52 7

Electricity charge @ 25% = 25% of (2400 + 5000.94 + 1265.544) = 2166.621 Rs

Meter charge = 240 Rs

Total electricity bill per month = 2400 + 5000.94 + 1265.544 + 2166.621 + 240 = 11,073.105 Rs

Table 3: Load consumption data of CII Godrej GBC (if it was a conventional building)

Items	Wattage	No's	Approx. working hrs/day	Energy Consumption (Wh/day)
Incandescent lamps	60	40	4	9,600
Fluorescent tube	35	110	5	19,250
Fan	60	38	5	11,400
Computer	150	15	4	9,000
Printer	70	15	0.5	525
T.V	250	2	5	2,500
Water cooler	1,000	5	8	40,000
Motor	1,100	1	2	2,200

Total Energy consumption per day = 9600 + 19250 + 11400 + 9000 + 525 + 2500 + 40000 +2200 = 94475 Wh/day = 94.475 KWh/day

Monthly energy consumption (KWh) = Energy consumption/day * No. of working days = 94.475 * 24 = 2,267.4 KWh

Total electricity bill per month in Rs:

Fixed charge = 2400 Rs

Meter charge = 240 Rs

Energy charge = 2267.4 × 4.9 = 11110.26 Rs

Fuel charge = 2267.4 × 1.24 = 2811.576 Rs

Electricity charge@25% = 25% of (2400 + 11110.26 + 2811.576) = 4080.459 Rs

Total electricity bill per month = 2400 + 11110.26 + 2811.576 + 4080.459 + 240 = 20,642.295 Rs

Total savings by CII- Godrej GBC is = 20,642.295 - 11,073.105

= 9,569.19 Rs per month

Table 4: Net Savings of Energy in terms of cost

Description	Electricity Bill per month (Rs)
CII- Godrej GBC (if it was a Green Building)	11,073.105
CII- Godrej GBC (if it was a normal conventional Building)	20,642.295
Net Savings	**9,569.19**

2. Water Efficiency:

Function of Jali in the downpours:

- Acts as a rain water authority through the openings which are given in the jali's and transmits it to the quick transfer/reusage region as appeared in Figure 8.

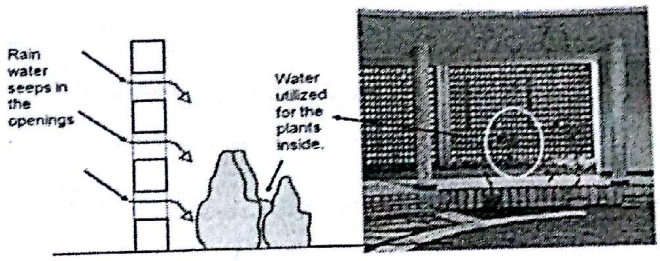


Figure 8: Jali system used for rain water collection in CII GBC

Rooftop Garden:

- Seepage into the ground has been introduced in person on foot zones and stopping.
- Rainwater accumulation and reuse by giving an inclining design as appeared in Figure 9.
- Waste-water and water keep running off is 100 % reused and diverted to one of three lakes, to be utilized for residential purposes.
- 35 % lessening of municipally provided consumable water.

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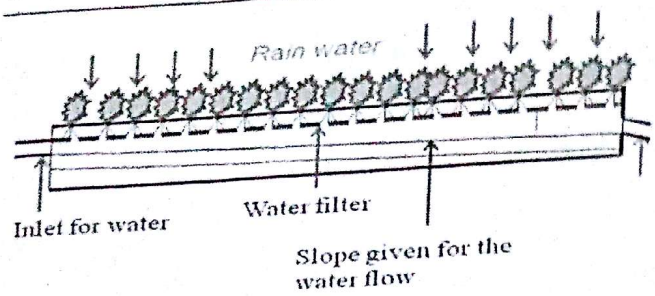

Figure 9: Rain water collection system in CII Godrej GBC

Water framework:

- Collecting water for outside utilize i.e. plant/washing auto as appeared in Figure 10.
- Use water moderating apparatuses including toilets, shower, taps, clothes washer and dish washer e.g. Low stream fixtures, water sparing double flush tanks
- Reduce water system and surface water keeps running off.

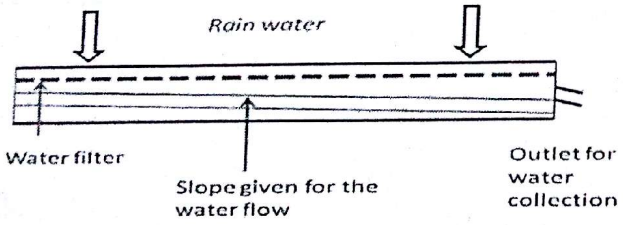

Figure 10: Rain water seepage system in CII Godrej GBC

Water Conservation Calculations

Parameters:

Office population: Fixed = 100 Floating = 150

Residential population = 25 (Employees like Security guards, Staff staying in CII – GBC)

Consumptions of water in Litres per capita demand (lpcd) for

Office population: 45 Litres/day

Residential population: 135 Litres/day

Peak Water Demand:

Maximum daily demand for

Office population = (100 + 150) × 45 = 11,250 Litres/day

Residential population = 25 × 135 = 3375 Litres/day

Total water demand = 14,625 Litres/day = 0.014625 MLD

Rain water harvesting:

Average Rainfall in Hyderabad = 803 mm/year = 2.2305 mm/day

Run off coefficient for Roof Top areas in Hyderabad = 0.80

Quantity of Rain water harvesting = Rainfall (m/day) × Area of catchment (m^2) × Run off coefficient

= 0.0022305 × 1858 × 0.80

= 3.3154152 m^3 / day [since 1 m^3 = 1000 Litres]

= 3315.4152 Lit / day = 0.003315 MLD (Million Litres / Day)

Extra water required after effective Rain water Harvesting Technique

= 0.014625 MLD - 0.003315 MLD

= 0.01131 MLD

From the above Water conservation data, we can simply say that amount of water which can be available through Rain Water harvesting is 22.667 % of the Peak Water Demand of CII Godrej GBC as shown in Table 5.

Table 5: Net Savings of Water Demand for CII Godrej GBC

Description	Units	Quantity
Peak Water Demand	MLD	0.014625
Water Collected through Rain Water Harvesting	MLD	0.003315 (22.66%)
Net Water Demand after effective utilization of Rain Water Harvesting	MLD	**0.01131**

ISBN: 978 93 83038 52 7

3. Sustainable Building Materials

An amazing 77 percent of the building materials utilize reused content as fly fiery remains, broken glass, broken tiles, reused paper, reused aluminum and soot from mechanical heaters, bagasse (an agrarian waste from sugar stick), mineral strands, cellulose filaments, and quarry tidy. The majority of the new wood was reasonably gathered, as affirmed by the Forest Stewardship Council.

- Costs 20% less than customary earth block fabricating.
- 65% dividers in GBC are developed with this material
- Low exemplified vitality, High reused content, low CO_2 outflow
- High quality, for all intents and purposes no breakage amid transport
- Uniform size of blocks lessens mortar required for joints and mortar by half.

Other Raw Materials utilized:

- Concrete utilized for development has 15% Fly slag and 20% GGBS
- 66% of the material was sourced inside a range of 800 km.
- 95 % of the crude material was removed or gathered locally.
- 77 % of the building materials utilize reused content as fly ash, broken glass, broken tiles, reused paper, reused aluminum, bagasse, mineral filaments, cellulose strands, and quarry tidy.
- Bagasse Board – by result of sugarcane industry-a decent substitute for plywood or Particle Board it has wide utilization for making parcels, furniture and so on.
- Most of the way routes laid in landscaping is stones/tiles which were left over materials in other development.
- An expansive measure of vitality and contamination was additionally decreased through decisions in the generation and transportation of building materials.

Waste Materials and 3R:

Each material has "Misfortune calculates", which portrays the amount of a specific material is normally lost amid capacity, transport and establishment of definite item. The assessed material waste rate varies according to development material. Today the construction industry is facing the issue of Management of huge construction waste. This research recommends the ways to reduce, reuse and recycle of construction waste in Indian context. Besides a clear understanding of the general concept of waste, it is helpful to use a classification of waste in different categories, in order to understand the wide range of possible corrective actions related to its prevention.

The different construction waste generated on site can be reduced, reused and recycled. Following are the possible measures towards waste minimization by implementing 3R concept to different waste materials on construction site which is shown in Table 6.

Table 6: Construction waste and 3R

S.No	Construction waste		Reduce	Reuse	Recycle
1	Soil			✓	
2	Cement		✓		
3	Sand		✓	✓	
4	Aggregate		✓	✓	
5	Concrete		✓	✓	✓
6	Steel		✓	✓	✓
7	Masonry		✓	✓	✓
8	Wood		✓	✓	
9	Tiles		✓	✓	
10	Pipes		✓		✓
11	Aluminum		✓	✓	✓
12	Glass		✓		✓
13	Plastic			✓	✓
14	Packaging material	Paint cans	✓	✓	✓
		Cardboard boxes	✓	✓	✓

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Table 7: Material Conservations data

Description	Total Embodied Energy (KJ)	Percentage
Construction Waste Produced	3549100	-
Reuse of Construction Waste	701654.5	19.76
Recycle of Construction Waste	636257.5	17.92

4. Occupant Comfort and Wellbeing

1. Approach and environment
   - Main passageway situated at the primary street
   - Surrounded by Medium Rise business structures
2. Entrance
   - The primary door opens to along carport with rich greenery on both sides making accentuation to the passage
   - The primary building has direct access from the fundamental street, But the passageway to it is from the inside to guarantee protection and security
3. Parking and openness
   - Building situated close to an open transport station
   - Most of worker uses bikes, and LPG autos for transportation purposes.
   - Use of battery worked vehicles – Charging stations are additionally accessible.
   - Encourage building tenants to minimize their dependence on fossil fuel-based transportation
4. Pedestrian course
   - Separation of Pedestrian and Vehicular development for simple course
5. Supportive structure for physically challenged
   - Easy route - utilization of inclines for course
   - Wheelchair inviting washrooms

5. Performance Monitoring and Validation

Building Management System (BMS) is a standalone amongst the most critical segments in developing a green building. It guarantees that the building stays 'Green', through its life. At the point when appropriately coordinated into an office, BMS can bring about the accompanying advantages:

- Optimize vitality utilization
- Provide alert frameworks to take restorative activities

Monitor and control Indoor solace conditions

Advantages of BMS:

- Operational vitality sparing to the degree of 15 - 20 %
- Maintenance of solace conditions
- Enhances indoor air quality
- Provides basic alerts and medicinal activities.

Accomplishments:

CII-Godrej GBC, which has accomplished the platinum rating, did an investigation of the vitality utilization of the working with and without the BMS. The outcomes uncover that there is a reasonable vitality sparing of 13%, when BMS is in operation.

6. Solid Waste Management

Standards followed in Waste lessening:

- Selecting the reused materials segments.
- Design for re-utilize and reusing.
- Control and lessen waste and bundling.
- Reduce asset utilization.

Figure 11

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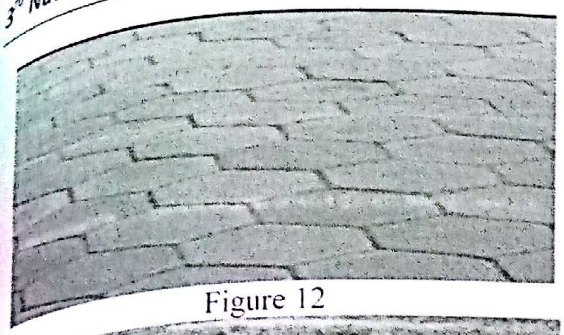

Figure 12

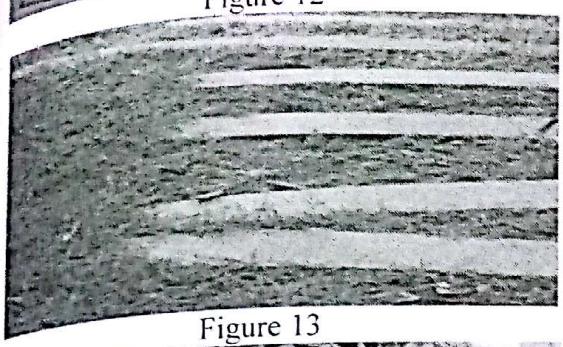

Figure 13

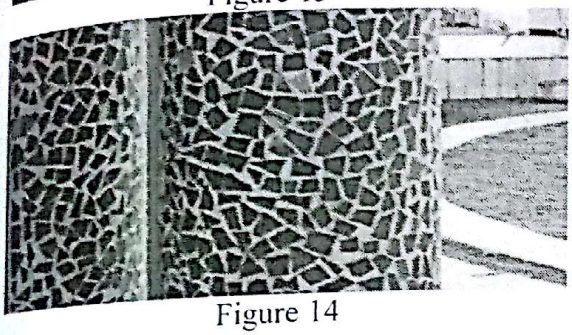

Figure 14

Figure 11 Furniture in the canteen with nearby Tandur stone

Figure 12 Stone network pavers utilized on streets for seepage of water

Figure 13 Reuse of waste stone in clearing the patio nurseries

Figure 14 Use of softened glass pieces up development of sections

Results and Discussions

1. Energy efficiency

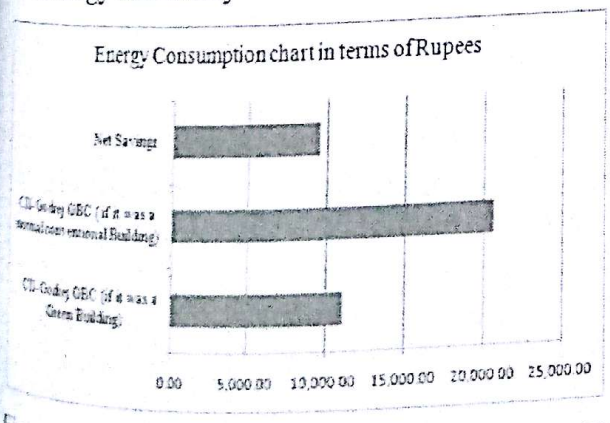

Figure 15: Energy Consumption chart in CII Godrej GBC

From Table 4, Figure 15 has been developed and it can be clearly say that Net savings of Energy in CII Godrej GBC is almost equals to the Energy Consumption cost of CII Godrej GBC

2. Water efficiency

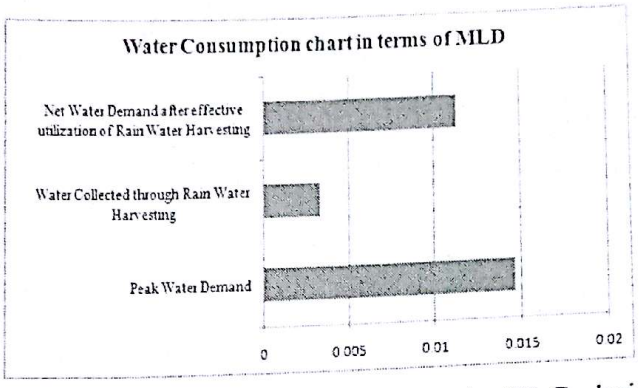

Figure 16: Water Consumption chart in CII Godrej GBC

From Table 5, Figure 16 has been developed and it can be clearly say that Net savings of water collected through Rain water harvesting accounts for 22.66% of Peak Water Demand, by imparting Green Building designing parameters.

3. Material efficiency

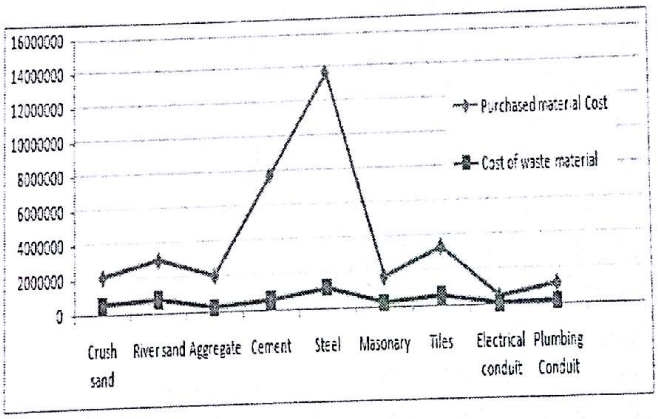

Figure 17: Material vs. Cost chart in CII Godrej GBC

From Figure 17 has been developed and it can be clearly say that Percentage wastage Cost due to waste material is very less in case of Electrical conduit (6.667%) and more in case of Crush sand (24.72%).

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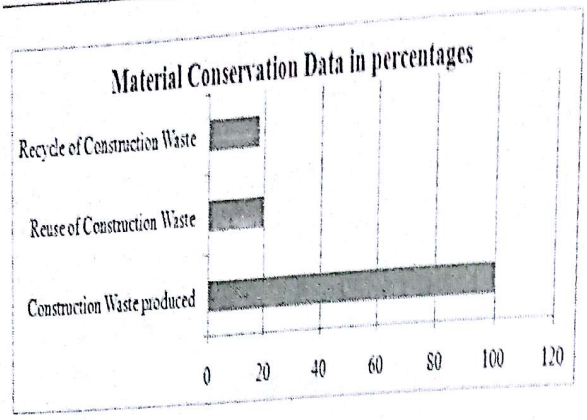

Figure 18: Material Consumption chart in CII Godrej GBC

From Table 8, Figure 18 has been developed and it can be clearly say that material conservation may be reduced by imparting Reuse and Recycling methods on construction wastes.

Research Limitations:

Till now Green Building planning contemplations are done just for the new structures practically speaking, however in the event that we change the current structures into a greener, we can accomplish a superior spot in acquiring a Green domain, either regarding decreasing the utilization of common assets, at the same time expanding the use of existing characteristic materials. In useful, transformation of existing structures into greener is a troublesome assignment, however it can be accomplished if and just if legitimate support and review is done on existing structures. Consideration ought to be taken before such change procedure, such that the current building ought to withstand the outlining contemplations of Green perspectives either as far as the subjective and quantitative angles too. In addition, we can supplant the current characteristic assets with the admixtures to lessen the utilization of common assets without adjusting the qualities of such structures. Similarly, the outlining contemplations may fluctuate in view of the area of that specific structure, before experiencing such perspective he/she ought to have an ability to plan taking into account climatologic angles.

Conclusions:

By considering every part of the Green building parameters, we can ready to decrease the usage of the normal assets viably. Before experiencing the outlining technique of any development climatologic viewpoints like temperature, mugginess and wind rose graphs are taken into contemplations, which significantly influence the planning criteria of such building. Standard rules are not kept up in the development perspectives, as they are re-changed and redesigned on a yearly premise. They are just intended to have down to earth information about the outlining thought and besides remaining part are absolutely done on a creative energy premise. Material choice assumes a significant part in the building plan and possesses a noteworthy segment in the development rehearse. Every material ought to be tried whether that material meets the Green building gauges or there will be consequences, those materials are to be supplanted by some different materials. Green Buildings are to be guaranteed based upon the subjective and the quantitative parts of that ensuring power. These affirmation levels may differ year by year because of inclusion of different files in the building plan.

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