

Planning and Design of Smart City and Green Building

Hemant Kumar Agrawal¹, Sunil Kanojia², Niti Kumari³

¹Assistant Professor Civil Engineering Department , Jagannath University Jaipur

²Research Scholar Jagannath University Jaipur

³Research Scholar Jagannath University Jaipur

Abstract - The construction industry poses a significant environmental threat such as those buildings account for at least 40 percent of worldwide energy utilization. Buildings absorb around 42 percent of worldwide water utilization and 50 percent of worldwide raw material use when the manufacturing, construction, and operational periods of buildings are considered. Furthermore, construction operations are responsible for 50 percent of global pollution specifically air and water, 42 percent of GHG emissions, 50 percent of all water pollution, 48 percent of whole solid wastes, also 50 percent of entire CFCs (chlorofluorocarbons). According to TERI estimates, the annual demand for electricity to meet end-use energy requirements for residential and commercial buildings has increased by roughly 5.4 billion units (kWh).

Key Words: optics, photonics, light, lasers, templates, journals

1. INTRODUCTION

These construction-related environmental issues are also faced by India. In 2004–05, the entire built-up region added to residential and business areas was roughly 40.8 million square metres, or about 1% of the yearly average completed floor area around the world, with trends indicating a 10% increase in the next years. Building energy consumption has increased from a low of 14 percent in the 1970s to over 33 percent in 2004–05, thanks to a near-consistent 8% increase in yearly energy consumption in the residential and commercial sectors (Song, et al., 2017). Unless sudden measure steps are made to enhance energy generation, energy consumption will continue to climb

These construction-related environmental issues are also faced by India. In 2004–05, the entire built-up region added to residential and business areas was roughly 40.8 million square meters, or about 1% of the yearly average completed floor area around the world,

with trends indicating a 10% increase in the next years. Building energy consumption has increased from a

low of 14 percent in the 1970s to over 33 percent in 2004–05, thanks to a near-consistent 8% increase in yearly energy consumption in the residential and commercial sectors (Song, et al., 2017). Unless sudden measure steps are made to enhance energy generation, energy consumption will continue to climb.

According to TERI estimates, the annual demand for electricity to meet end-use energy requirements for residential and commercial buildings has increased by roughly 5.4 billion units (kWh).

During the process of construction, buildings use major amount of water (for cooling, occupants and landscaping). In 1990, per capita water usage was 2464 m³ per year, but with a 1.4 billion population predicted by 2025, it will reach up to lesser than 1700 m³ per capita per year and this will lead it to the verge of stress category. According to information gathered from Indian state governments, around 93 percent of the metropolitan population had access to drinking water delivery facilities as of March 2004. Simply reflect accessibility; in some situations, the sufficiency, even-handed circulation, and per-capita arrangement of these essential administrations might miss the mark concerning the commanded guidelines. The impoverished, for example, especially population living in slums and stumpy communities, are frequently denied of these necessities. Similarly, water supply is vital not just for daily water demand for drinking purposes, but also for agricultural and other related industries.

While we are dealing with a water deficit, there is a big opportunity to bridge the resource gap by treating waste water and reusing it for multiple purposes. As indicated by the (CPCB) Central Pollution Control Board's evaluation of wastewater age and treatment in Class I and Class II urban areas in India during 2003-04, around 26 254 million litres each day (MLD) (9.51 billion m³ (BCM) was created in 921 Class I and Class II urban areas (housing more than 70 percent of urban population) also so far, waste water treatment capacity was 7044 MLD which accounts near about 27 percent of waste water generated in urban centres (2.57 BCM/year) (Kapshe, Manmohan, Paulose, Garima , & Akhilesh , 2013).

Another key difficulty that requires consideration is the management of construction and demolition trash, as well as solid waste generated by building tenants. The

CPCB estimates that 48 million tonnes of solid scrap is generated in India annually, of which 25% waste is contributed by construction industry.

Urbanization on a large scale is responsible of 'heat island' effect which is uncontrollable. Replacement of vegetation and tree covers by expansion of pavements extensively, construction of buildings and other structures results in take-off of cooling done by trees through evapotranspiration and shade.

As a result of this ozone is formed in the ground zone which has a harmful impact on human health. Due to urban heat island effects temperature can rise by up to 10 degrees Fahrenheit which automatically results in higher demand for AC. As the need for ac increases, there will be higher power generation which makes a significant contribution to greenhouse gas emissions. Due to all this, these matters needs to get proper attention

IMPACTS OF CONVENTIONAL BUILDINGS

Green Buildings are possibly the most suited solution to counter various environmental impacts that a conventional building produces in its life cycle. Conventional Buildings produces significant amount of greenhouse gas emissions and also various other damaging air pollutants. Buildings also produce lot of demolition waste, which obviously has a very bad impact on flora and wildlife. Conventional buildings use enormous amount of energy worldwide. As per the reports released by the IEA in 2008, more than 40% of global primary energy use and 24% of global CO₂ emissions are done by Existing Buildings.

During the whole life cycle of the building, it requires a lot of energy that majorly comes from the fossil fuels. There are lot of issues to get addressed but the big concerns are GHG emissions and indoor air pollution. Buildings not only release greenhouse gases but also variety of other contaminants also that are very dangerous. Outside air pollution is not just the case; in fact there may be possibility that air pollution within a



building is significantly

Higher. It is estimated that indoor pollution level can be 2 to 5 times more than the outside pollution level. Indoor air pollution parameter became relevant as we spend significant time in the building. One way to counter this parameter is to make sure that indoor air is timely replaced by the outside air that has less contamination in it. Conventional buildings are generally under-ventilated which unfortunately results in the air that is not safe to health of building inhabitants. On the other hand health and well-being of the inhabitants is the top most priority of green buildings.

Green building is totally linked to the concept of sustainable development and sustainability. The need of the study is due to the reason that green construction can result in: Running costs gets lower due to increased efficiency and less use of energy and water. Indoor air quality increases which leads to better public and resident health.

Effect of different ecological issues, for example, storm water spillover and the warming impact gets diminished

NEED FOR STUDY

The phrases "green building" and "high-performance building," "sustainable design," and "conserving precious resources" are often utilized reciprocally. "Green" in India, according to the CII, is defined as "the voluntary pursuit of any activity that is concerned with energy efficiency, environmental management, water management, renewable energy, waste management, and recycling." Green strategies at last add to long haul advancement and more equivalent development.

Green building is totally linked to the concept of sustainable development and sustainability. The need of the study is due to the reason that green construction can result in:

- 1) Running costs gets lower due to increased efficiency and less use of energy and water.
- 2) Indoor air quality increases which leads to better public and resident health.
- 3) Effect of different ecological issues, for example, storm water spillover and the warming impact gets diminished.

The body of the paper consists of numbered sections that present the main findings. These sections should be organized to best present the material.

It is often important to refer back (or forward) to specific sections. Such references are made by indicating the section number, for example, "In Sec. 2 we showed..." or "Section 2.1 contained a description..." If the word Section, Reference, Equation, or Figure starts a sentence, it is spelled out. When occurring in the middle of a sentence, these words are abbreviated Sec., Ref., Eq., and Fig.

At the first occurrence of an acronym, spell it out followed by the acronym in parentheses, e.g., charge-coupled diode (CCD).

WHAT IS A GREEN BUILDING

The goal to design a green building must be addressing all the negative environmental impacts that a building has on it over its whole life cycle like preserving ground cover, trees, water and energy which is getting diminishing as buildings are taking their place, various building operations and inhabitants' functions generate huge amount of garbage that needs to be either recycled or reused directly. It is very well known that designing and construction of a green building requires more cost than the other types of buildings. However, if it comes to the maintenance of the building it is known truth that it is less expensive to maintain a green building and also it has significant environmental benefits and in addition to that it also provides better living for its residents.

The spirit objective of the green structure is to decrease non-inexhaustible asset interest, increment the productivity of these when being used, and amplify the reuse, reusing, and use of sustainable assets. It amplifies the utilization of productive structure materials and development rehearses; enhances the utilization of on location sources and sinks through bioclimatic design rehearses; utilizes minimal measure of energy to drive itself; utilizes proficient hardware to meet its lighting, cooling, and different necessities; expands the utilization of sustainable power sources; utilizes effective waste and water the board rehearses; and gives agreeable and clean indoor working circumstances.

To summarize, the following areas of green building design are investigated in depth.

- 1) Site preparation.
- 2) Design of the building envelope.
- 3) Design of the building system (HVAC [heating ventilation and air conditioning], lighting, electrical, and water heating).
- 4) Generation of energy On-site with the help of renewable energy sources.
- 5) Management of water and waste.
- 6) Selection of environmentally sustainable materials.
- 7) The state of the indoor environment (maintains indoor thermal and visual comfort and air quality).



BENEFITS OF GREEN BUILDING

1) Generally when green buildings are compared to conventional structures, they use 40% to 60% less electricity. This is mainly due to their dependency on passive architectural interventions and high-efficiency materials and technology in the building's engineering design.

2) Green Buildings also make an effort to generate on-site energy through the use of renewable energy sources to meet their energy requirements. FOR EXAMPLE, Solar PV panels can assist in the generation of electricity, reducing the building's reliance on grid power.

3) Generally Green buildings use 40% to 80% less water than conventional structures.

Green buildings not only minimize their need for water by utilizing waste-water recycling systems and rain-water harvesting, but they also consider on-site supply sources to meet both internal and exterior (landscape) water demands.

GRIHA

India, a significant economy, is the world's 6th biggest country. The development business has a huge influence in the Indian economy, as seen by the nation's thriving land advancement. The change to a greener structure industry has ended up being inescapable considering the developing energy shortfall, asset shortage, and rising ozone depleting substance emanations. Since the most recent couple of years, the GRIHA, Simple Versatile Affordable GRIHA, and GRIHA for significant improvement rating frameworks have attempted to conquer these difficulties and accomplish maintainability. The GRIHA Council has contrived a rating framework for existing structures involving this as a benchmark. The GRIHA for Existing Buildings (EB) rating is an incorporated instrument for surveying existing structure execution and giving economical arrangements while further developing inhabitant solace. Structures that have been evaluated will have further developed energy and water productivity, as well as higher warm and visual solace, bringing about lower functional and upkeep costs. The ideal worth of the property cost and higher inhabitant maintenance of the reviewed structures will help business structures much more. The GRIHA for existing buildings rating was made in view of explicit objectives, like decreasing natural effect, simplifying it to carry out, lining up with nearby and public objectives, and being financially savvy. The rating means to give answers for different structure typologies and ages that oblige to India's various climatic zones, while additionally including RWAs and territory clients simultaneously. The grade would be founded on specific parts that are basic for the structure's general presentation improvement.

On a worldwide scale, efforts are being made to improve the efficiency of current structures. The Indian government is implementing a number of initiatives aimed at improving "Demand Side Management" in the energy sector. GRIHA envisions the implementation of an

Integrated process encompassing regulatory mandates, codes, and standards in India, as highlighted in India's "Intended Nationally Determined Contributions (INDCs): Working Towards Climate Justice" document submitted to the United Nations Framework Convention on Climate Change (UNFCCC) (Griha India). From couple of past years GRIHA has been aiming on new structures under the motto "what gets measured gets managed," and with a similar assurance, we will try to "Inspire, enable, and engage with society" and accomplish an economical living space for everyone.

GENERAL

Construction of Green buildings is one of the methodologies proposed to minimize the adverse



consequences of the existing structure stock on the climate, mankind, and wealth. The amount of examinations on green buildings has expanded in the last few years. The definition and extent of green structure, measurement of green structure benefits contrasted with existing structures, and various strategies to accomplishing green structures are pervasive topics. From the findings it was concluded that most of the work was focused on environmental aspect of green structure. Rest of the aspects of green building sustainability, particularly social sustainability, are largely ignored.

CONCEPT OF UTILIZATION OF WASTE ELEMENTS:

Basically, waste elements can be obtained from many sites as demolition sites provides recycled aggregates, power plants provide fly ash, fume, furnace slag, moreover these waste elements are broadly divided into many parts as domestic waste includes plastic and garbage and commercially waste includes rubber waste. Partially replacing Portland cement with waste materials will help to reduce environmental pollution as well as cement and other construction materials manufacturing. The conservation of the environment is one of our society's primary challenges.

An experiment was conducted on the presentation of concrete using solid waste fibers and discovered that the loading capability of concrete expanded, it also stated a limit of 2% of fibers could be utilized for strength and a maximum of 6% could be used for removal (Malagavelli & Paturu, 2011).

Using plastic waste as a coating over aggregates improved attributes of the aggregates, and that the ideal proportion of plastic, based on the stability values, was 6-8 %

(Sulna & Prasad, 2012).

provides better living for its residents

From the above information it can be assessed that conventional buildings have significant negative impact on the environment. So I have taken an existing conventional building

Located at Siddha, Jammu and try to analyses it as per GRIHA rating system discussed above.

On the basis of result I got I proposed some green practices so that my building should attain more points and my building gets optimized in various areas. The structure will produce less waste, use water efficiently and same in case of energy part also which will help the client to save money also so my building will be cost effective also in longer

2 LITERATURE REVIEW

GENERAL



Construction of Green buildings is one of the methodologies proposed to minimize the adverse consequences of the existing structure stock on the climate, mankind, and wealth. The amount of examinations on green buildings has expanded in the last few years. The definition and extent of green structure, measurement of green structure benefits contrasted with existing structures, and various strategies to accomplishing green structures are pervasive topics. From the findings it was concluded that most of the work was focused on environmental aspect of green structure. Rest of the aspects of green building sustainability, particularly social sustainability, are largely ignored.

2.1.1 CONCEPT OF UTILIZATION OF WASTE ELEMENTS:

Basically, waste elements can be obtained from many sites as demolition sites provides recycled aggregates, power plants provide fly ash, fume, furnace slag, moreover these waste elements are broadly divided into many parts as domestic waste includes plastic and garbage and commercially waste includes rubber waste. Partially replacing Portland cement with waste materials will help to reduce environmental pollution as well as cement and other construction materials manufacturing. The conservation of the environment is one of our society's primary challenges.

An experiment was conducted on the presentation of concrete using solid waste fibers and discovered that the loading capability of concrete expanded, it also stated a limit of 2% of fibers could be

Utilized for strength and a maximum of 6% could be used for removal (Malagavelli & Paturu, 2011).

Using plastic waste as a coating over aggregates improved attributes of the aggregates, and that the ideal proportion of plastic, based on the stability values, was 6-8 %

(Sultana & Prasad, 2012).

An experiment also conducted on the utilization of recycled plastic in form of a bunch of cells with dimensions ranging from 150mm * 150mm to 200mm * 120mm and depths ranging from 50mm to 100mm, which were laid over a compacted **base**, the analysis found that the process of construction can help in increasing the flexibility of concrete with little maintenance and that the surface does not break and the lifespan is estimated to be between 15-20 years (Pandey, 2012). By partially substituting the cement with fly ash helps in 25% of the volume consumption of cement, resulting in a 15% reduction in building costs provided fly

ash is collected effectively (Basak, Paria, & Bhattacharya, 2004). During 7-14 days substantial strength is less in the fly ash cement concrete, as per the completion of 28 days, the cement components and pozzolanic reaction result in quick hardening qualities, with 25% fly ash substitution (Suryawanshi & Nemade, 2012). It was discovered that using 50 percent fly ash as an additive improved the compressive strength of ordinary concrete (Chaudhary, 2012).

In an experiment it was discovered and reported that 15% -20% recycled aggregates by volume can be used to attain all of the qualities of regular concrete (Bindra, Sana, & Tadulkar, 2003).

Recycled and secondary aggregates can be utilised at a maximum of 20% -30% by volume without changing the w/c ratio to achieve all of the needed qualities of conventional concrete(Dhir & Paine, 2010).

It was found that no significant improvement in concrete strength after 7 and 28 days, but a substantial improvement in compressive strength after 90 days in blast furnace slag aggregate concrete (10.11%) compared to stone aggregates(Marik & Roy, 2005).

IJSREM sample template format, Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

An experiment also conducted on the utilization of recycled plastic in form of a bunch of cells with dimensions ranging from 150mm * 150mm to 200mm * 120mm and depths ranging from 50mm to 100mm, which were laid over a compacted base, the analysis found that the process of construction can help in increasing the flexibility of concrete with little maintenance and that the surface does not break and the lifespan is estimated to be

2.1.2 CONCEPT OF ENERGY EFFICIENCY:

Energy productivity is a proportion of how much energy is utilized to offer an assistance. By further developing energy effectiveness, the public will get and save additional energy from the energy that is presently being consumed. Energy proficiency implied utilizing less energy to achieve or make more undertakings or exercises. Besides, energy-effective growth should be seen as a fast and minimal expense way of new energy, as the expense of conveying energy can be cut altogether. Energy proficiency is basic for society's prolonged practicality.

Energy proficiency can also help to nourish processes, allowing for less energy to be used to provide many facilities such as lighting, heating, ventilation, and air conditioning (HVAC), and so on. Energy efficiency is widely recognised as a means of lowering greenhouse gas (GHG) emissions. To accomplish energy efficiency, use electrical feeding that is energy efficient, such as employing light-emitting diode (LED) light bulbs and sensor systems, passive design, and cross ventilation and while using renewable energy sources such as solar energy is another smart approach to improve energy efficiency (Hussein & Chen, 2015).

The energy consumption of GB technology indicated a 50 percent and 43 percent annual reduction in energy usage in the Indian building industry and the American home, respectively(Dong , Andrew, & Jing, 2016).

Integrated design approaches have been claimed to lower energy consumption by 72 percent, however projects can be more expensive than individual solutions(Ramesh & Imran , 2016).

It was investigated the HVAC system's energy consumption characteristics (Jinkyun, Sancho, Jonghurn, & Hiki, 2014). The empirical investigation decline was explored by a group of scientists within a range of -0.4 to 21%(L.N. & K.N., 2016).

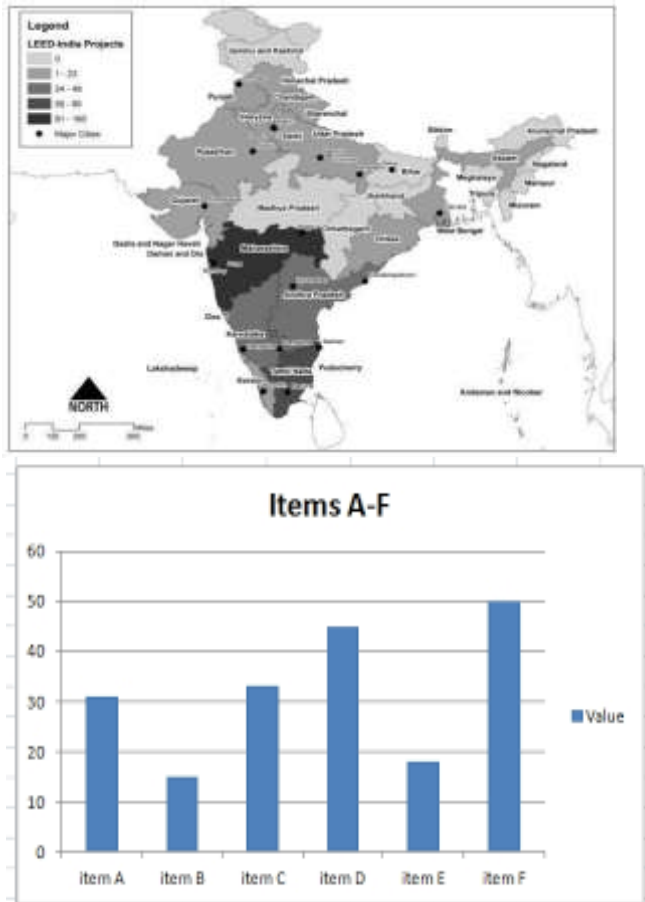
The use of a double skin green front on high-rise structures in Hong Kong to reduce energy consumption. He indicated that the solar conduction of lone and multiple layers of creeping florals like Virginia creeps varies between 0.43 and 0.14, and that it can reduce solar output by 40-80%(Wong & Baldwin, 2016).

Between 15-20 years (Pandey, 2012). By partially substituting the cement with fly ash helps in 25% of the volume consumption of cement, resulting in a 15% reduction in building costs provided



Fig -1: Figure

Charts



2.1.3 GREEN BUILDING RATING SYSTEM:

A green building rating system is a method for assessing a building's environmental performance throughout its life cycle. It usually consists of a set of standards that encompass many aspects of a green building's design, construction, and operation. Each criterion contains a set of pre-assigned points and establishes verifiable performance standards and targets. Once a project meets the rating criteria, it is given points. The points are totaled to determine a project's final rating. Rating systems need a project to be evaluated by an impartial third party, and several mechanisms are in place to assure a fair evaluation. Green building grading systems have been significant

Various appraisal tools have been made to support the advancement of green structures like Leadership in Energy and Environmental Design (LEED, USA), BRE Environmental Assessment Method (BREEAM, UK), Green Building Council of Australia Green Star (GBCA, Australia), Green Mark Scheme (Singapore), DGNB (Germany), Comprehensive Assessment System for Built Environment Efficiency (CASBEE, Japan), Pearl Rating System for Estidama (Abu Dhabi Urban Planning Council), Hong Kong Building Environmental Assessment (Malaysia)(Jian & Zhen, 2013).

All of these green building assessment tools are offered on a voluntary basis rather than as a requirement. It was created by each country's or region's green building council. The assessment is carried out by green building council-commissioned accredited personnel. The World Green Building Council was formed to bring together the activities of several green building councils around the world (Jian & Zhen, 2013)

2.1.3.1 COMPARISON BETWEEN LEED-INDIA AND GRIHA

In India, number of green projects have been registered for certification or have already been certified under the LEED or GRIHA systems. A wide range of projects like a small individual level home to huge developments of up to 123 acres are part of these projects.

According to data obtained from the relevant organisations, 810 green projects in India are under review or have been accredited by the two ranking systems; GRIHA has 365 projects under consideration for certification, whereas LEED-India has 445 projects registered for certification(Smith, 2015). As

Figure 2: Complete number of LEED-India projects in India by state/union territory. Source: IGBC.



Figure 3: All out number of GRIHA projects in India by state/union territory. Source: ADARSH.

2.2 RESEARCH GAP

Strategy and market obstacles, monetary and financial hindrances, data advancement and training boundaries, and managerial and organizational barriers were recognized through a review of literature. The end of these holes could well affect the green development industry. A portion of the singular holes are of the 'mutual benefit' assortment, which are moderately easy to fill since they exclusively bring about wins. Simultaneously, there are tradeoff holes that could bring about pay misfortune.

1) STRATEGY AND MARKET OBSTACLES:

An outside hole coming about because of insufficiency of guideline because of an absence of sufficient motivators for the advancement of green structure, unfortunate execution and execution of building and energy codes, unfortunate norm of appointing structures, and different variables that adversely influence a partner's advantages. Green rating methods are not broadly utilized because of the unassuming size of green structure markets, and thus, expenses and resale values are not sufficiently alluring to captivate financial backers.

Absence of financial motivating forces as expense exception or awards for interests in green structures by the public authority on account of interest in green structures.

Non-execution of the building regulations in the country (National Building Code and

Energy Conservation and Building Code), which helps avoidance from development guidelines.

Trouble in understanding the rating instruments by the financial backers, making them incredulous of the evaluations.

Absence of interest and supply side push prompting slow take off of green structures.

Time taken in authorizing an undertaking and no transparency of the framework.

2) MONETARY AND FINANCIAL HINDRANCES:

Green structure take-up is hampered by the expensive beginning venture, restricted monetary assets, and financial plan imperatives. What's more, the area has different difficulties like an absence of delicate advances, a long reimbursement period, and trouble evaluating benefits. Green structures are viewed as having high capital uses and a long bring period back. A potential obstruction is the danger of peril considered by banks and monetary speculations on

Credit reimbursement by clients because of a hazy pace of profit from green ventures. In this area, there are divided impetuses on the grounds that the entertainers who spend the cash and the financial backers who benefit from the speculation are not something similar. Green development is tied in with moderating energy, water, and space while additionally taking advantage of

them. Measurement of the worth of green structure ventures is oftentimes a hole.

High beginning speculation expenses of new green and supportable strategies goes about as a deterrent in putting resources into elite execution building.

Non-unwinding in loan fees from monetary foundations for new pursuits with high introductory speculation costs.

The recompense time of such speculations is high and returns are low. They can't get

Alluring charges or higher rents in spite of the benefits they have.

Absence of interests in green structures because of heterogeneity between the individuals who burn through cash on further developing structure highlights and the people who receive reward out of them.

Apathy toward green structures emerging because of the absence of estimation and trouble in evaluating possible investment funds in energy, water and waste from the reception of a specific methodology.

3) DATA ADVANCEMENT AND TRAINING BOUNDARIES:

This hole create because of data unevenness, an absence of information and ability in building life cycle costing, etc. Uneven data on specialized and the board components has large amounts of the area, affecting the venture choices of different undertakings and partners.

Uneven data concerns subjects, for example, energy proficiency, energy naming, development codes, squander, etc.

Need is given to the underlying expense of development and beginning use leaving out the computations on use throughout the existence season of building. There is an absence of aptitude in carrying out methods/highlights connected with green structure.

Time and asset expenses to investigate the highlights and items which are more energy proficient, water-saving and waste limiting is very high.

Absence of appropriate information on the monetary, ecological, wellbeing and innovative advantages emerging out of green structures.

High prerequisite of new gear, foundation, and gifted experts to get into green development.

Befuddling rating frameworks and their focuses and problematic needs and realism in execution.

4) MANAGERIAL AND ORGANIZATIONAL BARRIERS:

This hole happen inside because of the board and authoritative designs that disincentive partners, coming about in poor green structure speculations. Capital planning, everyday booking of standard errands, clashing timetables, anxiety toward surpassing timetable and financial plan, and discontinuity and majority in the area, for instance, all outcome in stagnation and apply strain on partners, bringing about thinks twice about green reasons.

Exploring different avenues regarding another plan might infer spending plan over runs and the critical rationale to work under the designated financial plan goes about as a boundary for new green highlights.

A recent fad or example of development can antagonistically influence the serious conveyance time and can bring about plan clashes

Unbending nature to embrace new practices because of opposition towards change,

Carelessness and inclination to adhere on to 'business as usual.'

Clashes from need conflicts emerging from short-term agreements and assortment of partners.

No motivators as benefits or charges for the partner to empower the shift to the green highlights.

2.3 RESEARCH OBJECTIVES

Green building (which is otherwise known as green construction or sustainable building) refers to a structure as well as the use of environmentally responsible and resource-efficient processes throughout the life-cycle of a building: from site selection to design, construction, operation, maintenance, renovation, and demolition. In other words, green building design entails striking a balance between home construction and environmental sustainability.

Objectives of present study are-

1. Study of efficient construction materials and practises; increases the use of natural sources and sinks in the building's surroundings; reduces the amount of energy used to run the building; employs highly skilled equipment for the indoor area; employs highly skilled water and waste management methods. Lighting, air conditioning, and all other necessary equipment are included in the indoor equipment.
2. To investigate how the development and operation of a building has a detrimental influence on the environment and how to mitigate it.
3. To research energy conservation through the use of green construction concepts, as well as various strategies for reducing water usage, treating and reusing waste water, and filtering water received from precipitation.
4. To model an existing Residential Building on Revit.
5. Analyze and Optimize that Residential Building.

3 METHODOLOGY

3.1 GENERAL

In this chapter I am going to discuss the methods which I have taken into consideration to obtain the results of my study. I have taken GRIHA rating systems for my project and various criteria and rating process of it is discussed below.

3.2 RATING PROCESS

1) FEASIBILITY CHECK

The owner and maintenance team is accountable for inspecting the facilities and housekeeping as a primary step. They must use the GRIHA website's online feasibility check calculator to see whether their project falls under the criteria of GRIHA for existing buildings grade and fulfilling the necessary conditions. Based on the provided information by project supporter then calculator finally predicts the level of rating. The feasibility check rating is only an indicator; the final rating will be given after the project has been registered and the provided documents have been assessed and validated by the GRIHA Council.

2) REGISTRATION

After passing the feasibility check, the project proponent can register the proposal on the GRIHA Council's website under the Existing Building category by submitting an expression of interest (EOI) form. After the completion of registration process, project supporter will be given a login and password to access the online panel's documentation.

3) ORIENTATION WORKSHOP

Further registration process is followed by a GRIHA Council-led orientation workshop. The goal is to supply extensive data on already existing building ratings, as well as to answer specific questions about the certification process from project proponents.

4) DOCUMENT SUBMISSION

Following the orientation session, the project supporter will submit all documents using the username and password supplied at registration on the web panel.

5) PRELIMINARY EVALUATION

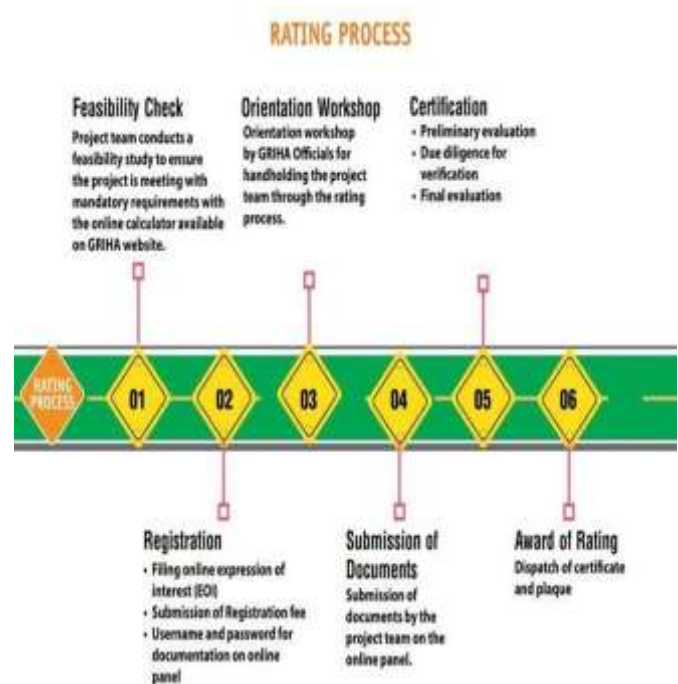
Following the online submission of papers, group of experts and professionals from the Council of GRIHA conducts a preliminary evaluation. For all attempted criteria, the documentation must be complete in every way. Any attempted criteria lacks insufficient documentation will not be further assessed. Filling out and submitting online calculators for specified criteria are required. Professionals from the GRIHA Council examine the project's compliance with the mandatory requirements first, and will get rejected, if it does not lie in the provided norms. The GRIHA Council will next assess the elective norms and calculate the sum total of scores that can be earned. Within 20–25 working days of receiving the documents, a preliminary review report must be produced.

6. DUE DILIGENCE SITE VISIT FOR VERIFICATION

the GRIHA Council must conduct a due diligence site visit to compare the supplied documentation to the on-site execution. After the site visit, the due persistence report must be submitted within seven-ten working days.

7) FINAL EVALUATION

The GRIHA Council assesses papers presented in response to the preliminary assessment and due persistence report. Once required material is collected from the Final score card will be generated by GRIHA council based on this review within 20–252 working days, once the project team provides needed material from the preparatory assessment and due application report.



3.3 CRITERIA AND THEIR WEIGHTAGE

The GRIHA for already existing structures rating is a production-based methodology in which points are awarded for satisfying the criteria's intent (appraisals). Points were allocated for each criterion. Compliances must be provided in the relevant criterion and then must be submitted in the provided format. While few of the criteria are self-validating by nature, as energy usage, eye and thermal comfort, noise management, and levels of indoor pollution, must be checked on-site by performance monitoring. After verification by optimizing validation and documents/photographs to support the award of point, the points connected to these criteria (as provided in the sections) are granted.

GRIHA for existing buildings is a 100-point grading system with 12 criteria divided into seven sections: Site Parameters, Maintenance & Housekeeping, Energy,

Water, Human Health & Comfort, Social Aspects, and Bonus Points. Six of the twelve requirements are required, while the remaining six are optional.

Except for the six necessary requirements, each criterion has a number of points attached to it. It indicates that a project that aims to achieve the criteria will be eligible for points.

Based on the number of points achieved, several levels of certification (one to five stars) are awarded. Certification requires a minimum of 25 points.

Threshold	GRIHA Rating Policy
25-40	★
41-55	★★
56-70	★★★
71-85	★★★★
86 and above	★★★★★

Figure 5: Threshold and Stars in GRIHA. Source: GRIHA India.

. WATER EFFICIENCY

Water efficiency becomes prioritized criteria for evaluating an existing structure. This section recognises improved technology and practises that reduce the usage of potable water supplied by municipal local bodies. It also focuses on implementing no-cost or low-cost water conservation methods, as well as water recycling and reuse, to improve overall water performance.

Integrative strategies like double pipes, low stream apparatuses, on location sewage treatment, downpour water gathering, etc are probably going to be investigated while a structure's underlying retrofitting is assessed concerning water effectiveness; in any case, they are conservative in the drawn out run. Thus, the embraced water preservation measures would be compensated, and their execution would be considered as a component of the structure/long haul venture's feasibility.

Section 1. SITE PARAMETERS

The section focuses on two areas of the site: basic service accessibility and reducing the influence of the Urban Heat Island Effect (UHIE).

One of the primary criteria that impacts the amount of energy utilised by inhabitants in transportation is their availability to general amenities from the project site provided. This component of the site characteristics tries to lessen the negative environmental impact of using automobiles for general assistance accessibility. The 2nd portion of this area focuses on improving the project site's microclimate.

Criterion 1.ACCESSIBILITY TO BASIC SERVICES

To meet the occupant's basic needs, this criterion aims to limit the usage of private automobiles and this will enhance people to walk, cycling

Criterion 2. MICROCLIMATIC IMPACT

The main aim of the work is to enhance tree planting and to put in place suitable measures on-site to mitigate the effects of the cities heat group effect and to improve the project site's microclimate.

Section 2. MAINTENANCE & HOUSEKEEPING

Facility management is critical to the operation and upkeep of all operations in an existing building. Building upkeep, tasks and housekeeping, the utilization of practical and harmless to the ecosystem strategies and

items, the utilization of low ozone depletion materials, and waste administration are completely compensated in this part. This segment looks at execution observing and approval in the upkeep/retrofitting and housekeeping manuals of associations

Criterion 3. MAINTENANCE, MANAGEMENT

This measures' goal is to confirm that fine practises are followed in building system operation and maintenance, so that environment-friendly products are used for

Housekeeping

Criterion 4. METERING & MONITORING

The vitalize precise metering of the energy and water utilized by the building so that we can analyse the performance is the goal of this criterion. Harvesting setup will take to cover the entire cost that is going to be invested initially. In this I have done cost estimation of conventional water bill vs. new rainwater harvesting setup. The cost estimation of conventional part is simple as it is purely from the water bill of the building. In addition to that I have taken into consideration initial miscellaneous

Criterion 7. WATER FOOTPRINT

The main aim of the work was censurability of water for numerous uses and to identify prospective regions within the project boundaries where water consumption might be reduced.

Criterion 8. REDUCTION IN CUMULATIVE WATER PERFORMANCE

The objective of the rule is to energize reusing of water to meet non-compact water necessities while additionally bringing down absolute water interest from the nearby civil stock/ground water..

Section 5. HUMAN HEALTH & COMFORT

This segment centers around expanding human wellbeing and solace regarding building tenants' warm, visual, and acoustic solace. An additional concern is good quality of fresh air (IAQ: Indoor air quality) and quantity, which is assessed using established markers.

Criterion 9. ACHIEVING INDOOR COMFORT REQUIREMENTS (THERMAL, VISUAL, AND ACOUSTIC)

The objective of this basis is to affirm, that the structure's inside regions are agreeable for building occupants with regards to warm, visual, and acoustic solace.

Criterion 10. MAINTAINING GOOD IAQ

The objective of this criterion is to give great and natural air quality for all building tenants.

Section 6. SOCIAL ASPECTS

This region is committed to advancing boundary free access for the older and distinctively abled. This part likewise centers around raising issues connected with climate among the structure's clients and guests.

4. Results and discuss

In this Chapter I will discuss about the Results I got in our project. I modelled our building in REVIT 2019. This includes Floor plans, Elevations, Schedules and View of the Building which.

After making the whole structure in REVIT, I applied all the criteria of GRIHA in the conventional building and got a score of 24. As per this score this building falls in zero (0) star category of GRIHA green rating system.

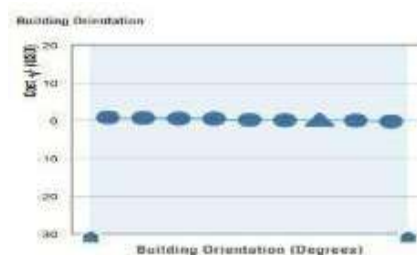
As the score obtained by the building is 24 but this is not the highest score that can be

Achieved by this building. We can increase this score by applying various green practices like use of renewable source of energy (e.g. : use of solar energy), rain water harvesting, treatment of grey water on site etc. After applying green practices and modification of this building the score can be updated upto 70-75 (approximately).

After doing all this modelling and getting tentative scores from both the conventional and proposed green building I am now determined to perform the required practices/techniques that are mandatory to achieve the score approximately equal to number discussed above.

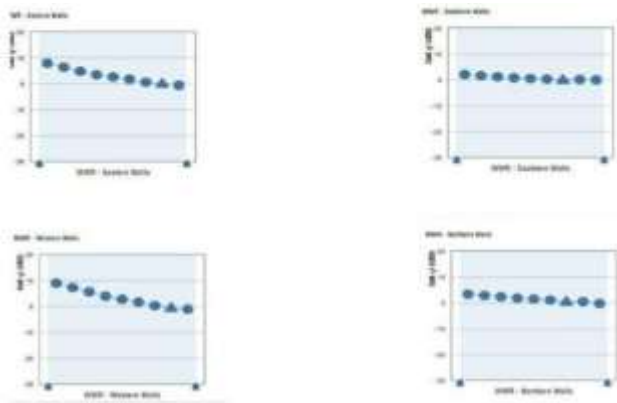
ENERGY ANALYSIS

First of all I have done energy analysis of the building and obtained the following results: For operation and functionality of a building and maintaining the comfort of user a significant amount of energy is required. For the estimation of needed energy demand energy balance is necessary.



Orientation of our building.

Building performance is significantly affected by windows and the parameter which shows how much portion of exterior wall is comprises of windows is called as Window Wall Ratio (WWR). Following graph shows the WWR of our building from each directions.



: WWR of our building from each direction.

Another parameter is plug load efficiency. This is not considered to be important earlier but as the time is changing and buildings are becoming more energy efficient, the impact of plug loads are becoming significant. This parameter is very important as in high productive buildings, plug loads may be 50% of the total energy use. Graph shows the plug load

In the present study, I have analyzed our building in REVIT 2019 software and found that our building is nearly optimized. Parameters like orientation of building, window wall ratio, plug load efficiency falls in acceptable limits.

4.1 RAINWATER HARVESTING:

Then I have designed a rainwater harvesting setup which is as follows:

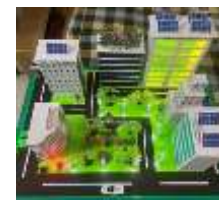
Daily Rainfall data from 1989 to 2018 is considered for analysis.

State Rainfall Mean:

Table 1 shows the mean precipitation (mm) of the state for the rainstorm months, southwest storm season and yearly during the period 1989-2018. It very well may be seen that the state gets most noteworthy precipitation (33%) of south west storm precipitation in July month while the August month get 32% of the south west rainstorm precipitation. June and September get 15% and 18% of south west rainstorm precipitation. Practically 44% of yearly precipitation is gotten during the southwest rainstorm season as it were.

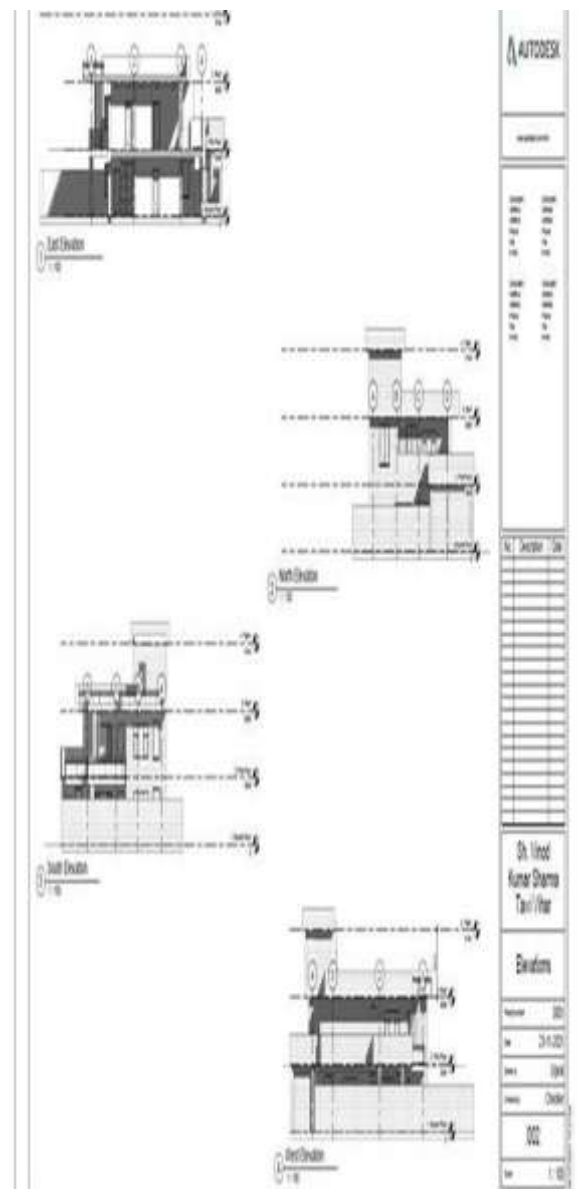
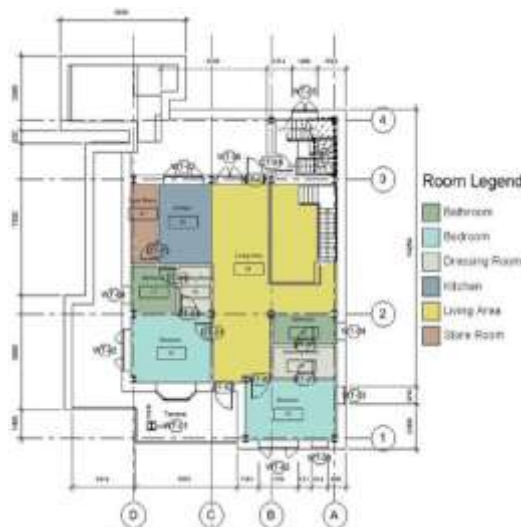
Month	Rainfall (mm)	Inflow (ltrs)	Cumulative Inflow (ltrs)	Outflow (ltrs)	Cumulative Outflow (ltrs)	Inflow- Outflow (ltrs)
Jan		10192				
Feb	70	16307.2	10192	19375	19375	-9183
Mar	112		26499.2	17500	36875	-1192.8
Apr		14560				
May	100	8736	41059.2	19375	56250	-4815
June	60		49795.2	18750	7500	-10014
July		3640				
Aug	25		53435.2	19375	94375	-15735
Sept	101.2				132500	-4044.4
Oct						
Nov						
Dec						
Yearly						39010.6

After doing all these operations I finally in the position to compare our building on the basis of GRIHA parameters. I tried to maximize the score of our building from the previous one and also succeeded in our goal. I estimated that we can achieve the score of 70-75 but I fell short by 10-15 points and got 60 points which means that my building falls in 3 star category as per GRIHA criteria



After meeting the optimized water demands for our building, I further proceed for its storage in the water tanks. So for that, I have opted to go for a circular R.C.C. underground water tank instead of rectangular one because rectangular R.C.C. water tank is a complex structure and there are lot of stresses that are coming on the structure in comparison to circular one and its going to be costlier also. I can also go for the plastic water tanks but as per the present market scenarios the amount of water we need to collect; plastic water tanks are going to be costlier option. As cost effective parameter is also there so I chose circular R.C.C. underground water tank. Also if we are going to place plastic water tanks on the roof, it just add up the load on our structure which eventually leads to crack formation which may results in the failure of structure. So, from this study we can

conclude that rectangular R.C.C. water tanks are more feasible and eco-friendly option for making Green buildings. After this I take a dig at costing



And estimation part, as initial cost of rainwater harvesting setup is high so it is mandatory to check whether this setup is convenient to replace the previous one. For this I compared the conventional setup cost and the rainwater harvesting setup cost and found that our breakeven period is 19 years. This means that our building willnot going to spend even a single penny on water after a time period of 19 years. From the above indings I conclude that, after performing all the required and feasible green Practices (water efficiency, energy efficiency) I have attained a 3 Star rating as per GRIHA criteria.

4.3 RAINWATER HARVESTING:

Then I have designed a rainwater harvesting setup which is as follows:

Daily Rainfall data from 1989 to 2018 is considered for analysis.

State Rainfall Mean:

Table 1 shows the mean precipitation (mm) of the state for the rainstorm months, southwest storm season and yearly during the period 1989-2018. It very well may be seen that the state gets most noteworthy precipitation (33%) of south west storm precipitation in July month while the August month get 32% of the south west rainstorm precipitation. June and September get 15% and 18% of south west rainstorm precipitation. Practically 44% of yearly precipitation is gotten during the southwest rainstorm season as it were.

Table 1: Mean rainfall (mm) of the state for the monsoon months, southwest monsoon season and annual.

Rainfall Mean of Jammu District

My project site is situated at Sidhra (Distt. Jammu). Therefore to use rainwater I need to get data about it. So below table gives the rainfall statistics for the Jammu district of Jammu and Kashmir

Table 2: Rainfall statistics for Jammu district of Jammu and Kashmir for the four monsoon months, southwest monsoon season and annual.

Month	June	July	August	September	Monsoon Annual
Mean	101.2	401.8	394.5	138.7	1036.1 1388.9

From the above table I can conclude some results which are as follows:

- 1.) Annual mean rainfall of Jammu district : 1388.9 mm
- 2.) The trends show that highest mean rainfall in Jammu district is received in the month of July which is 401.8 mm.

To utilize the rain water, I have to calculate the amount of water I can collect. For collection of water we will take the peak amount of rainfall which is usually received during the month of July and the value is approximately equal to 400 mm(as per the study from 1989-2018).

The catchment area will be area of rooftop which is approximately equal to 182 sq. Meter (13m*14m). Amount of water that will be available for the peak rainfall (400 mm) and

Month	Rainfall (mm)	Inflow (ltrs)	Cumulative Inflow (ltrs)	Outflow (ltrs)	Cumulative Outflow (ltrs)	Inflow-Outflow (ltrs)
Jan		10192				
Feb	70	16307.2	10192	19375	19375	-9183
Mar	112	14560	26499.2	17500	36875	-1192.8
Apr						
May	100	8736	41059.2	19375	56250	-4815
June	60	3640	49795.2	18750	7500	-10014
July	25		53435.2	19375	94375	-15735
Aug						
Sept	101.2				132500	-4044.4
Ann						39010.6

After taking the water demand into the consideration the amount of rainwater that needed to be stored: 39010.6 litres.

As there are enormous amount of good water is lost in leakages.

Therefore, approximately water that need to be collected: 37000 litres.

= 37 cubic meter

Design of Circular Underground Water Tank with Rigid Base:

As I have calculated earlier, the amount of water which is to be stored in our water tank is 37 cubic meter.

As I am designing a circular Water Tank, therefore the dimensions of the tank are as follows: Required Volume = 37 cubic Meter.

Let height of the tank = 3 m and Let the free board height be = 0.2 m Thickness = 0.2 m

So, Required Volume of tank = $(\pi/4) \times R^2 \times H$

$37 = (\pi/4) \times R^2 \times 3$

Implies $R = 1.98$ m which is approximately equals to 2 m.

Final dimensions of the Water Tank are $D = 4$ m ; $H = 3$ m ; $T = 0.2$ m Therefore, Volume of the Water Tank provided = 37.69 cubic Meter which is greater than Required Volume.

As I am working on underground tanks so the very first step towards a sound system design is assessing the site conditions. As per IS 15797: 2008 The five main site conditions to be

assessed are: a) Availability of suitable roof catchment, b) Foundation characteristics of soil near the house, which includes Soil properties like type of soil which is Sandy Clay Loam in our case with approximate saturated unit weight of 17.5 kN/m^3 and as per correlations of strength characteristics for soils graph mentioned in Design Manual of Soil Mechanics the $\phi(\Phi)$ value corresponding to the above unit weight is 27 degree which can be taken as 25 degrees approx.

- c) Location of trees,
- d) Estimated runoff to be captured per unit area of the roof, and
- e) Availability and location of construction material

The M25 grade of concrete and Fe415 Steel is used for calculation. There are two conditions as per which the tank is to be designed: Condition 1: When water tank is empty and there is saturated soil pressure outside. Condition 2: When water tank is full and there is no soil pressure outside.

Unit weight of water = 10 kN/m^3 Submerged unit weight of soil = 7.5 kN/m^3

Active earth pressure coefficient $K_a = (1 - \sin \Phi) / (1 + \sin \Phi) = 0.41$

Condition 1: When water tank is empty and there is saturated soil pressure outside.

Active earth pressure = $(K_a \cdot \gamma' \cdot H) + (\gamma_w \cdot H)$

We know that concrete is good in taking compressive stresses.

Condition 2: When water tank is full and there is no soil pressure outside.

Thickness of wall shall be: From top $0 - 0.4H = 150 \text{ mm}$

$0.4H - 0.7H = 175 \text{ mm}$

$0.7H - H = 200 \text{ mm}$

Hoop Tension as per Table 9 of (IS 3370 Part – IV) = $C1 \cdot \gamma_w \cdot H \cdot (D/2)$

Table 4: Values of C1 for different heights.

The value of C1 is the maximum among the above values. i.e. $C1 = 0.62486$

Therefore Hoop Tension = $C1 \cdot \gamma_w \cdot H \cdot (D/2)$

$= 0.62486 \cdot 10 \cdot 3.2 \cdot (4.4/2)$

$= 43.99 \text{ kN}$

Area of Steel = $(43.99 \cdot 10^3) / 130 = 338.38 \text{ mm}^2$ (for two zones) Minimum Steel Percentage = 0.24%

Area of steel at $0.5H = (0.24/100) \cdot 1000 \cdot 175 = 420 \text{ mm}^2$

(Provide 10 mm dia @ 180 mm c/c = 436 mm^2)

$= 0.245 \text{ N/mm}^2$

As $0.245 \text{ N/mm}^2 < 1.3 \text{ N/mm}^2$ so, OK.

4.4 QUANTITY AND COST ESTIMATION

I have also done the quantity estimation, cost estimation of our circular underground R.C.C. water tank and the results of these are as follows:

The following table shows the quantity estimation of our underground water tank. Table 8: Quantity estimation of circular underground R.C.C. water tank

5 CONCLUSION

Green building concept is best in the business to minimize energy usage, water consumption, various pollutions such as water and air, to encounter the needs of the time, to magnify residents quality of life. In the upcoming times, green building will become principal cultural notion, to fascinate people to purchase, for better relationship between humans and nature and many other parameters like common development circumstances. As there is progress in technology and economic growth, one of the biggest barrier to human's lives is the environmental problems, because with time people living environment is getting worse and

it's a high time to notice of various environmental issues and take a step towards protecting

our environment. Green building is one of the step. This sunrise mechanization concept in construction sector has an era-making significance, as it can minimize waste, improve utilization of resources, and also reduce nature destruction activities of human. The utilization of environmental friendly energy saving technologies enabling green energy saving

technologies to maximize their effectiveness in construction. In this project I have chosen a conventional building and tried to convert it into green building to avail all the benefits discussed above. The three basic parameters of green building are water efficiency, energy efficiency and material efficiency. As the building is in existing form therefore material efficiency part cannot be performed. I can work on rest two parameters. I designed rainwater harvesting setup and also performed energy analysis. After performing energy analysis I found that our building is nearly optimized. Parameters like window wall ratio, plug load efficiency falls in acceptable limits. Also in rainwater harvesting part I can conclude that our building water demand can be met if I collect water efficiently. In addition to that I also compared the conventional setup cost and the

rainwater harvesting setup cost and found that our breakeven period is 19 years. This means that our building will not going to spend even a single penny on water after a time period of 19 years. After performing whole processes I managed to attain three star rating from GRIHA parameters. This report revealed that Green buildings provides a promising medium for efficiently saving energy and water that will

Further help in sustainable use of resources for prolonged period of time.

REFERENCES

- 1) Retrieved from <https://www.wienerberger.in/green-building/why.html>
- 2) Retrieved from Griha India: www.grihaindia.org
- 3) Dhir, R., & Paine, K. (2010). Value added sustainable use of recycled and secondary aggregates in Concrete. Indian Concrete Journal, 7-26.
- 4) Wong , I., & Baldwin, A. (2016). Investigating the potential of applying vertical green walls to high-rise residential buildings for energy-saving in sub-tropical region. Building and Environment, 34- 39.
- 5) Basak, S., Paria, L., & Bhattacharya, A. (2004). Utilization of Fly Ash in Rural Road Construction in India and its cost effectiveness. Electronic journal of Geotechnical Engineering(EJGE), 04 – 36.
- 6) Bindra, S., Sana, K., & Tadulkar, S. (2003). Investigation of the quality of concrete made using recycled cement mortar as fine aggregate for Road Pavements, Proc. National Conf. Modern Cement Concrete and Bituminous Roads. GITAM College of Engineering, Vishakhapatnam (India), 266-274.
- 7) Chaudhary, S. (2012). High Volume Fly Ash Concrete: An innovative, cost effective, durable and eco- friendly material for cement concrete roads. Journal of Indian Highways, 13-20.
- 8) Dong , Z., Andrew, M., & Jing, D. (2016). An Empirical Study on the Energy Consumption in Residential Buildings after Adopting Green Building Standards. 145 Procedia Engineering, 766 – 773.
- 9) Hussein, M. A., & Chen, M. A. (2015). Energy Efficiency in Green Building to Achieve Company Sustainability. Proceedings of Symposium on Technology Management and Logistics .
- 10) Jian , Z., & Zhen, -Y. (2013). Green Building Research–Current Status and Future Agenda : A Review,. Renewable and Sustainable Energy Reviews .
- 11) Jinkyun, C., Seunggho, S., Jonghurn, K., & Hiki, H. (2014). Development of an energy evaluation methodology to make multiple predictions of the HVAC&R system energy demand for office buildings. Energy and Buildings, 169–183.
- 12) Kapshe, Manmohan, Paulose, N. K., Garima , S., & Akhilesh , S. (2013). Analysing the Co-benefits: Case of Municipal Sewage Management at Surat, India. Journal of Cleaner Production, 51-60.
- 13) L.N., D., & K.N., A. (2016). Green buildings cost premium: A review of empirical evidence . Energy and Buildings, 396–403.
- 14) Malagavelli, V., & Paturu, N. (2011). Strength characteristics of concrete using Solid Waste—an experimental investigation. International Journal of Earth Sciences and Engineering, 937-940.
- 15) Marik, S., & Roy, D. (2005). Performance of Blast Furnace Slag as a coarse aggregate in Concrete. International Conference on Structural and Road Transportation Engineering, 244-251.
- 16) Pandey, B. (2012). Low Cost Concrete Roads for Villages,Workshop on Non-conventionamaterials/Technologies. Central Road Research Institute, New Delhi, 39-41.

- 17) Ramesh, S., & Emran , K. (2016). Energy efficiency in green buildings .Indian concept, Volume 3, Special Issue 3, 329-33.
- 18) Smith, R. M. (2015). “Green” building in India: a comparative and spatial analysis of the LEED-India and GRIHA rating systems. Asian Geographer, DOI: 10.1080/10225706.2015.1020065.
- 19) Song, P., Xingru , W., Shen, W., Chuanqi, X., Xingxing, Z., Jingchao, X., et al. (2017). Energy waste in buildings due to occupant behaviour. The 8th International Conference on Applied Energy , 2233 – 2238.
- 20) Sultana, S. A., & Prasad, K. (2012). Utilization of Waste Plastic as a Strength Modifier in Surface Course of Flexible and Rigid Pavements. International Journal of Engineering Research and Applications (IJERA), 1185-1191.
- 21) Suryawanshi, N., & Nemade , P. (2012). Use of Ecofriendly Material like Fly Ash in Rigid Pavement construction & it's cost –benefit analysis. International Journal of Emerging Technology and Advanced Engineering, Vol.2, 795-800.