A PROJECT

MONETARY COMPARISON AND MODELLING OF JUIT GREEN HOSTEL

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Under the supervision of

Prof. Ashok Kumar Gupta

Professor and Head

By

SABAL GUPTA
(131034)

SHANU GUPTA

(131648)

AMIT KALTHAIK

(131663)

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY

WAKNAGHAT, SOLAN – 173 234

HIMACHAL PRADESH, INDIA

CERTIFICATE

This is to certify that the work which is being presented in the project report titled "***MONETARY COMPARISON AND MODELLING OF JUIT GREEN HOSTEL"*** in partial fulfillment of the requirements and submitted to the Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat is an authentic record of work carried out by Sabal Gupta (131034), Shanu Gupta(131648), Amit Kalthaik(131663) during a period from August 2016 to May 2017 under the supervision of **Prof. Ashok Kumar Gupta,** Professor and Head, Department of Civil Engineering, Jaypee University of Information Technology, Waknaghat.

The above statement made is correct to the best of our knowledge.

Date: - April 27, 2017

Project Guide

Prof. Ashok Kumar Gupta

Professor & Head

Civil Engineering Department

JUIT Waknaghat

ACKNOWLEDGEMENT

We have taken a lot of efforts in this project. However, it would not have been possible without the kind support and help of many individuals and organizations. I would like to extend my sincere thanks to all of them.

I am highly thankful to Prof. Ashok Kumar Gupta for his guidance and supervision as well as for providing necessary information regarding the project & also for his support in completing the project.

I would like to express my gratitude towards my parents & my friends for their kind cooperation and encouragement which help me in the completion of this project.

Sabal Gupta(131034)

Shanu Gupta(131648)

Amit Kalthaik(131663)

ABSTRACT

This report aims at studying the different features of a Green Building and preparing a 2D model in AUTOCAD and 3D model in REVIT of Conventional Building and Green Building.

Green building deals with the various energy saving concepts which can be incorporated at the time of planning, designing, construction and execution stage to have energy efficiency keeping in mind the cost perspective. The green building has incorporated with various parameters for energy savings and modeled in the software Autodesk REVIT. REVIT efficiently integrates environmental analysis into the design and delivery of high-performance buildings. A comparison between the conventional hostel and green hostel is done on the basis of energy cost.

<u>**CONTENTS**</u>

LIST OF TABLES

LIST OF FIGURES

CHAPTER -1

INTRODUCTION

1.1 GENERAL

Green building is the act of making structures and utilizing forms that are ecologically mindful and asset proficient all through a building's life-cycle from siting to design, construction, operation, support, redesign and deconstruction. This practice grows and complements the established building configuration worries of economy, utility, solidness and comfort. Green building is otherwise called a maintainable or elite building.

Green structures are intended to lessen the general effect of the assembled condition on human well being and the common habitat by:

Proficiently utilizing water and different assets, protecting inhabitant wellbeing and enhancing worker profitability, reducing waste, contamination and natural corruption. For instance, green structures may fuse economical materials in their development (e.g. reused content, or produced using inexhaustible assets); or potentially include arranging that lessens water usage (e.g., by utilizing local plants that get by without additional watering).

1.2 NEED FOR STUDY

Land improvement (real estate construction) utilizes around 40% of the resources and it is one of the prime supporters of an unnatural weather change because of the emanation of Green House Gas (GHG). Along these lines there is an extraordinary need to create green structures. The idea of reasonable improvement can be followed to the vitality (particularly fossil oil) emergency and natural contamination worries of the 1970s.

Green building unites an inconceivable cluster of practices, strategies, and aptitudes to decrease and at last dispense with the effects of structures on the earth and human wellbeing. It frequently underscores exploiting inexhaustible assets, e.g., utilizing daylight, dynamic sun orientation, and photovoltaic gear, and utilizing plants and trees through green rooftops, rain and lessening of water keep running off. Numerous different strategies are utilized, for example, utilizing low effect building materials or utilizing pressed rock or penetrable cement rather than traditional cement or black-top to improve recharging of ground water.

1.3 OBJECTIVES

• To study different features of a Green Building.
• To develop a 3D model of the Green building using REVIT.
• Monetary comparison of Conventional building with Green Building.

1.4 SCOPE

The scope of this project is to prepare a model of green building highlighting all the efficient features favoring the environment using AUTOCAD software and REVIT software in a hot and humid climate. Energy analysis is done manually as well as through software. A comparison of material cost and energy cost will be done between conventional building and green building

Chapter-2

LITERATURE REVIEW

2.1 GENERAL

A green building consolidates ecological contemplations into each phase of the building development and concentrates on the outline, development, operation and upkeep stages. The key procedure contrast amongst green and customary structures is the idea of reconciliation, whereby a multi-disciplinary group of building experts cooperate from the pre-outline stage through post-inhabitance to advance the working for ecological manageability, execution, and cost sparing.[2]

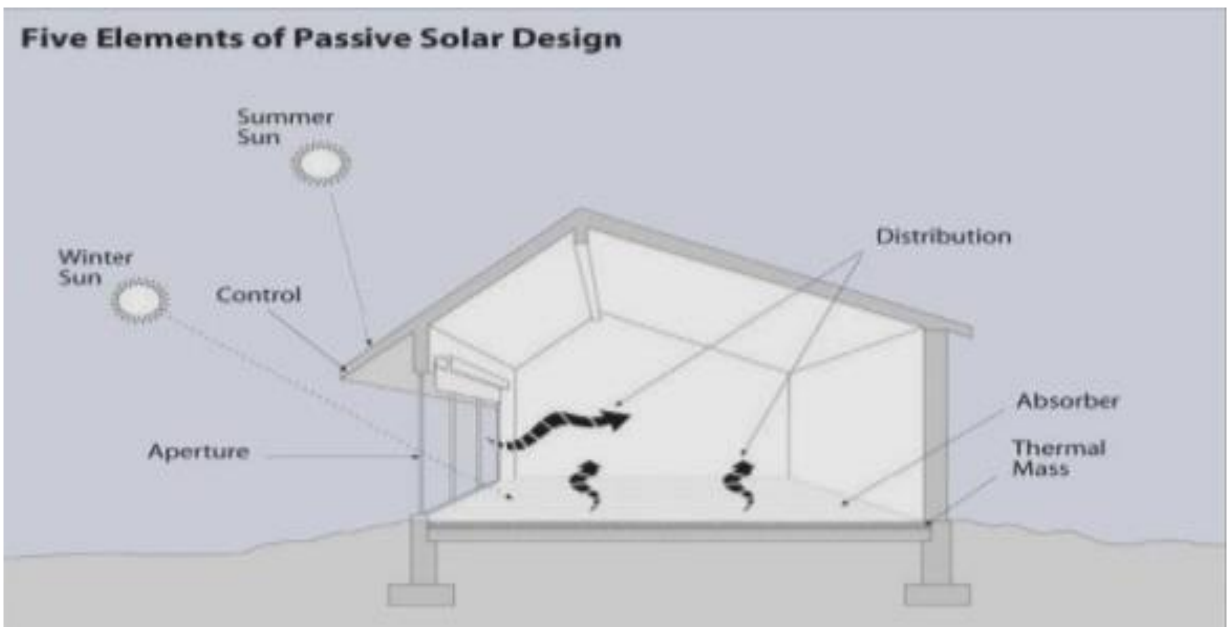


Fig1.Five elements of passive solar design

Structures intended to fill in as dynamic sun based authorities ought not be shaded by close-by trees or structures and ought to have sunlight based clusters or rooftop zone confronting south.

2.2 Orientation of building

Building orientation refers to the way a building is arranged on a site and the situating of windows, rooflines and different elements. A building focused for sun oriented outline exploits inactive and dynamic sun powered procedures. Daylight or insolation utilises vitality from the sun to warm and light up structures. Inactive sun powered warming procedures additionally give chances to day lighting and perspectives to the outside through well - situated windows. Uninvolved cooling expels or rejects heat from the building, keeping temperatures cool. Keeping away from any mechanical operations to direct temperature accomplishes vitality and cost investment funds by lightening the cooling load requested. Shading gadgets can likewise lessen undesirable sun oriented picks up by obstructing the sun amid the mid year months, while characteristic ventilation, which depends on regular wind stream and breezes, can diminish the requirement for mechanical cooling when the building is possessed. The accompanying five components constitute an entire inactive sunlight based plan. Each plays out a different capacity, yet every one of the five must cooperate for the outline to be effective: gap, safeguard, warm mass, dispersion, and control.[3]

How to Optimize Building Orientation

• Light retires/overhangs or other shading gadgets which adequately shade the south-bound rise from the late spring sun; south rise shades ought to be even while east and west rises more often than not require both level and vertical shades.

•Less windows on the east and west face of building, and ideally minimum on the north.

2.4 WASTE REDUCTION

Green design additionally tries to lessen misuse of vitality, water and materials utilized amid development. For instance, in California about 60% of the state's waste originates from business structures amid the development stage; one objective ought to be to lessen the measure of material going to landfills. Very much outlined structures additionally help diminish the measure of waste created by the inhabitants too, by giving nearby arrangements, for example, compost containers to lessen matter going to landfills. To diminish the measure of wood that goes to landfill, Neutral Alliance (a coalition of government, NGOs and the woodland business) made the site dontwastewood.com. The site incorporates an assortment of assets for controllers, districts, designers, temporary workers, proprietor/administrators and people/mortgage holders searching for data on wood reusing. At the point when structures achieve the finish of their helpful life, they are ordinarily decimated and pulled to landfills. Deconstruction is a strategy for reaping what is ordinarily viewed as "waste" and recovering it into helpful building material

2.5 MODELLING OF BUILDING USING REVIT

Revit was planned to enable draftsmen and other building experts to outline and report a working by making a parametric three-dimensional model that included both the geometry and non-geometric outline and development data, which later ended up noticeably known as Building Information Modeling or BIM.

REVIT programming is particularly worked for Building Information Modeling (BIM), enabling plan and development experts to convey thoughts from idea to development with a planned and reliable model-based approach. Revit is a solitary application that incorporates highlights for compositional plan, auxiliary designing, and development. It permits to outline a building and structure and its segments in 3D, clarify the model with 2D drafting components and get to building data from the building models database.

The Revit workplace enables clients to control entire structures or congregations (in the venture condition) or individual 3D shapes (in the family manager condition). Autodesk Revit Architecture is a building outline and documentation stage in which a computerized fabricating model is made utilizing parametric components, for example, dividers, entryways, windows, et cetera.

All the building components have intrinsic association with each other, which is followed, overseen and kept up by the PC. Utilizing the 3D components of Revit, we can envision the compositional or inside regarding its scale, volume, and extents. This empowers us to study outline choices and create predominant quality plan arrangements. Autodesk Revit Architecture robotizes routine drafting and coordination undertakings and helps with lessening mistakes in documentation. This, thus, spares time, enhances the speed of documentation, and brings down the cost for client.

CHAPTER-3

COMPONENTS OF GREEN BUILDING

3.1 TROMBE WALL

A Trombe wall is an inactive sun powered building plan where a divider is based on the winter sun side of a working with a glass outer layer and a high warmth limit inside layer isolated by a layer of air.[1]

- Works in gentle climate and more efficiently in winter climates as well.
- But can lose a lot of warmth around evening time unless they are protected.

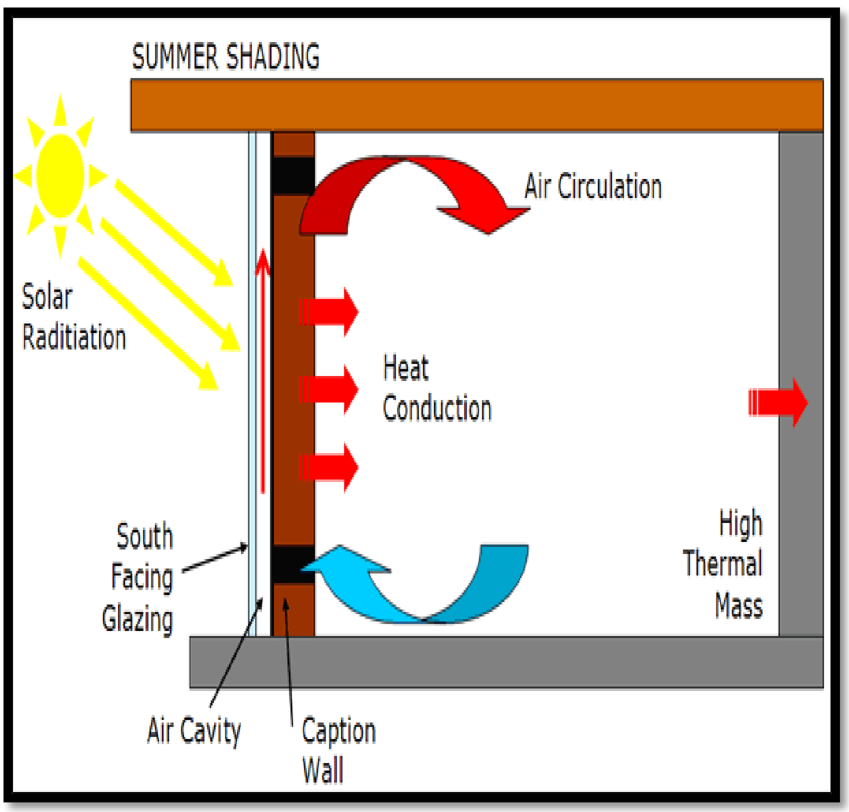


Fig. 2 Working of Trombe Wall

3.2 SKYLIGHTS

Sky facing windows are light transmitting fenestration (components filling building envelope openings) shaping all, or a part of the top of a building's space for day lighting purposes. Sky lighting sorts incorporate rooftop windows, unit sky facing windows, tubular day lighting gadgets (TDDs), inclined coating, and custom sky facing windows.

Fig. 3 Skylight in an office

3.3 SOLARIUM

Solarium refers to Sunroom, a room built largely of glass to afford exposure to the sun.

Fig. 4 Solarium3.4 CAVITY WALL

Cavity walls consist of two 'skins' separated by a hollow space (cavity).

It is utilized to decrease warm misfortune through a hole divider by filling the air space with material that restrains warm exchange. This immobilizes the air inside the depression (air is as yet the genuine separator), forestalling convection, and can generously decrease space warming

Fig. 5 Traditional construction in Spiti using straw, grass for insulation

3.5 SUNSPACE

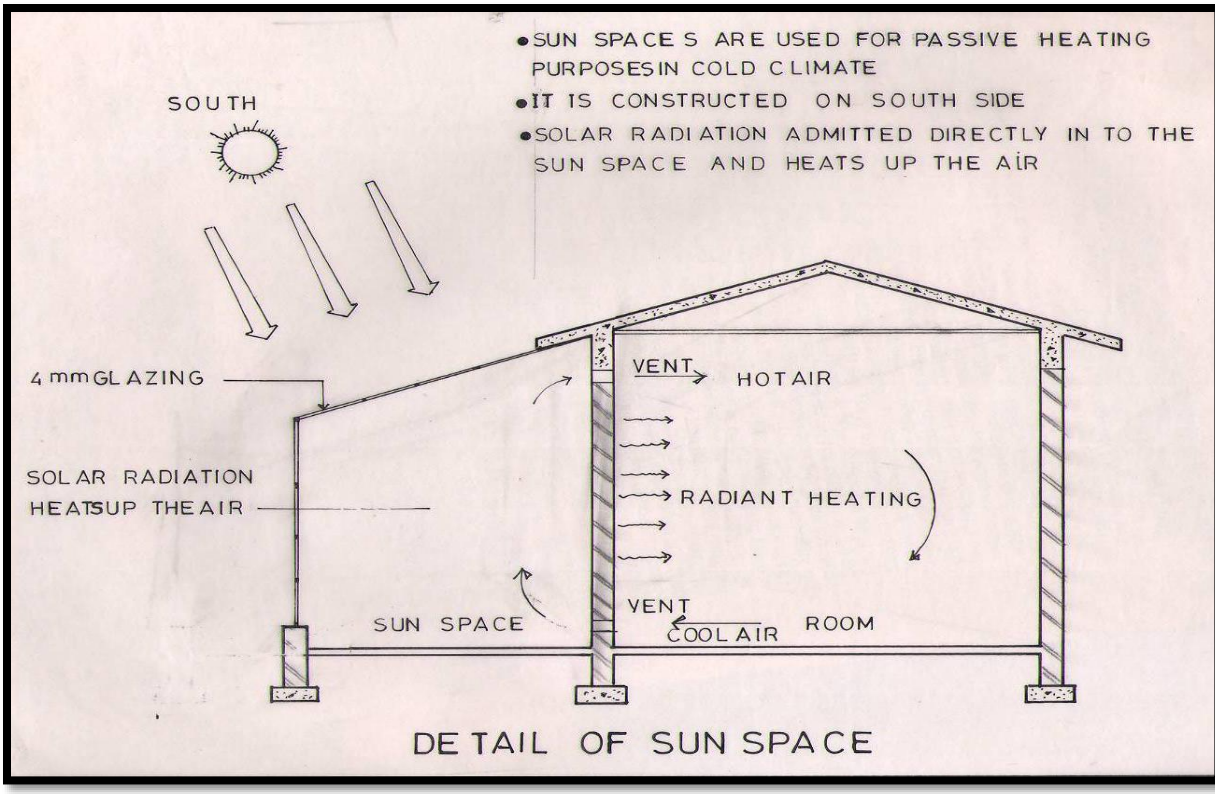


Fig. 6 Sun Space

3.6 WINDOW BOX HEATER

There is a continuous recirculation of air inside chamber. As air gets warmed up, it rises and the recirculation continues.

Fig. 7 Window Box Heater

Fig. 8 Food placed in black vessel in Window Box Heater

3.7DOUBLE GLAZED UNITS

Twofold coated window comprise of two layers of glass with a layer of latent gas fixed between them. This makes about double the protection as single coated units. Once fixed, the unit ends up noticeably sealed shut. The air gap does not allow the heat to escape.[5]

Fig. 9 Double Glazed glass pane

CHAPTER-4

CASE STUDY

4.1 ANALYSIS CONSIDERING SJVNL BUILDING, SHIMLA

Energy Efficiency :

Use of High Efficiency Windows

- **Solar window:**

  Photovoltaic windows not only provide a clear view and illuminate rooms, but also use sun light to efficiently help generate electricity of the building.

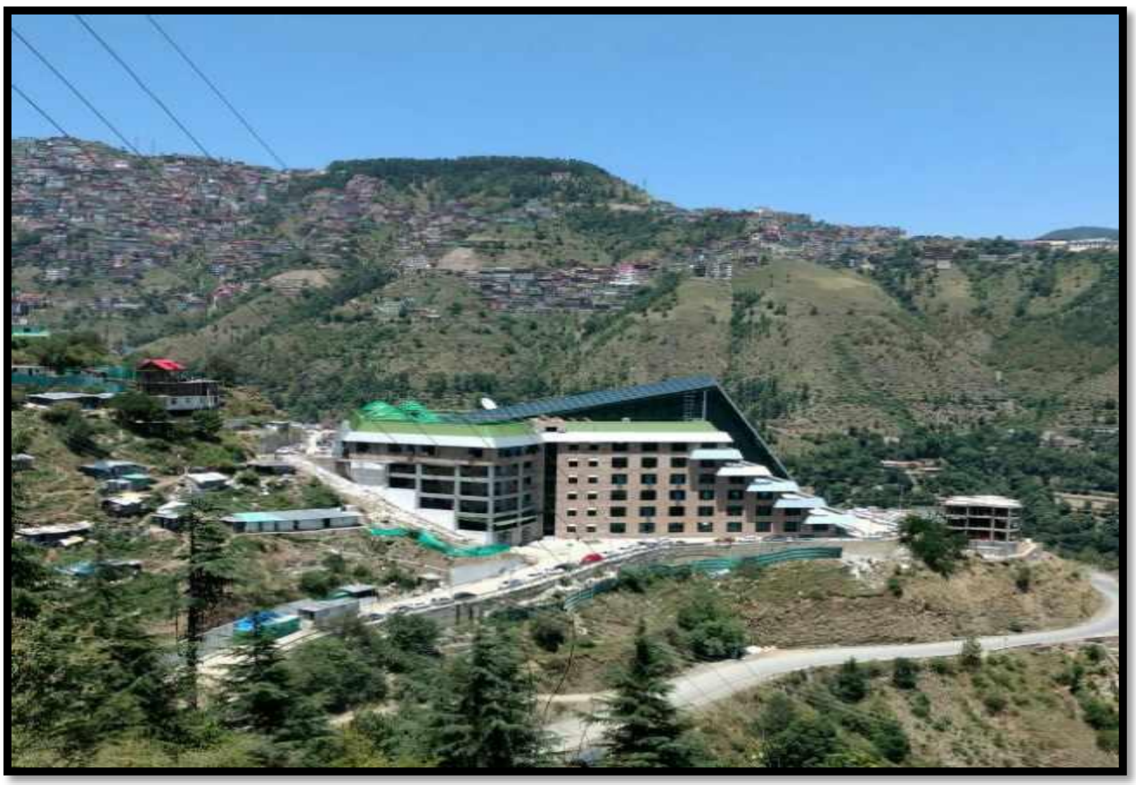


Fig. 10 SJVNL Green Building in Shimla

- **Roof window:**

A sloped window used for day lighting.

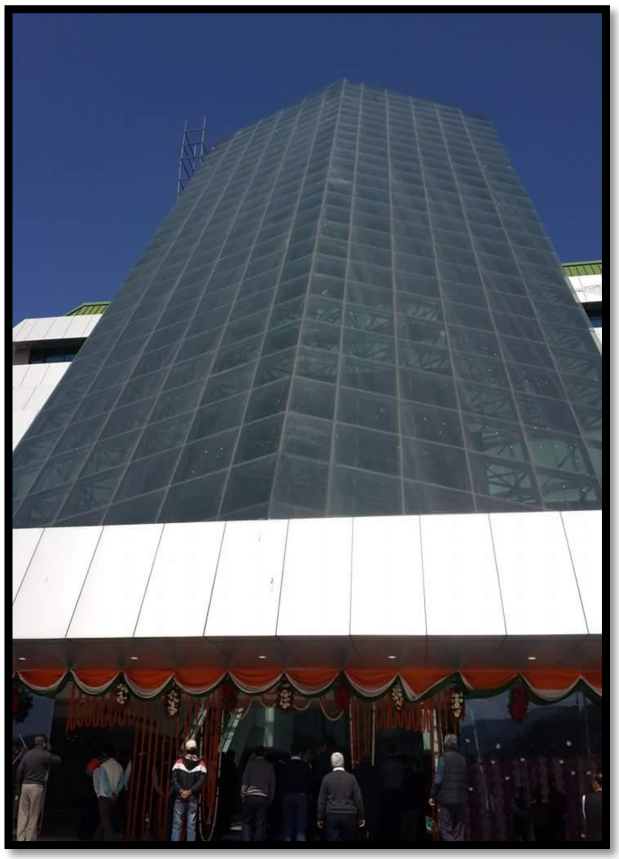


Fig. 11 Solar Windows and Roof Windows are used in SJVNL for Energy Efficiency.

WATER EFFICIENCY

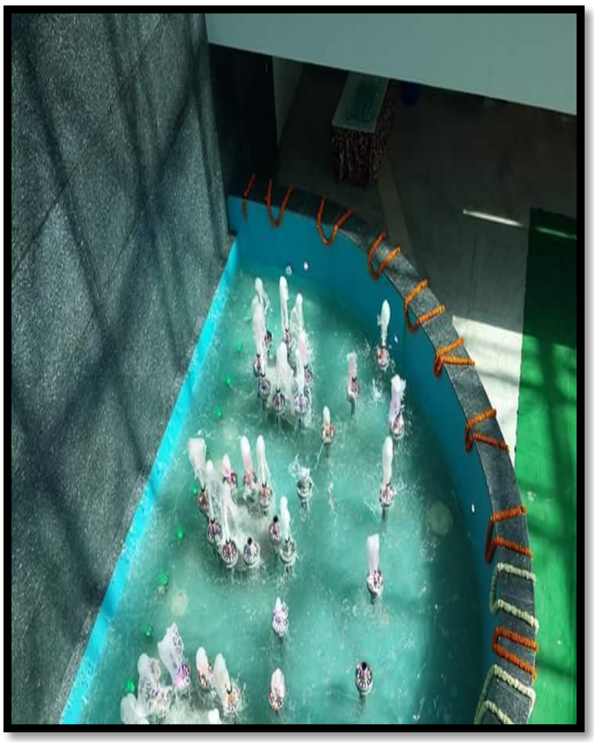
Protection and conservation of water through out the life of a building may be accomplished by:

- Designing for dual plumbing hat recycles water in toilet flushing.
- Use of ultra-low flush toilets.
- Use of low-flow shower heads.
- Reuse of grey water for Watering gardens.
- Rainwater Harvesting.

Fig. 12 On roof 'Collector Drain Pipes' are there which are attached to 'Rain Water Harvesting pit' at the ground

WASTE REDUCTION

- By providing on-site solutions such as compost bins to reduce matter going to landfills.
- "Greywater", waste water from sources such as dish washing or washing machines, can be used for sub surface irrigation, for non-potable purposes, e.g., to flush toilets, water fall landscapes and wash cars.
- By collecting human waste at the source and running it to a semi-centralized biogas plant with other biological waste, liquid fertilizer can be produced.[1]



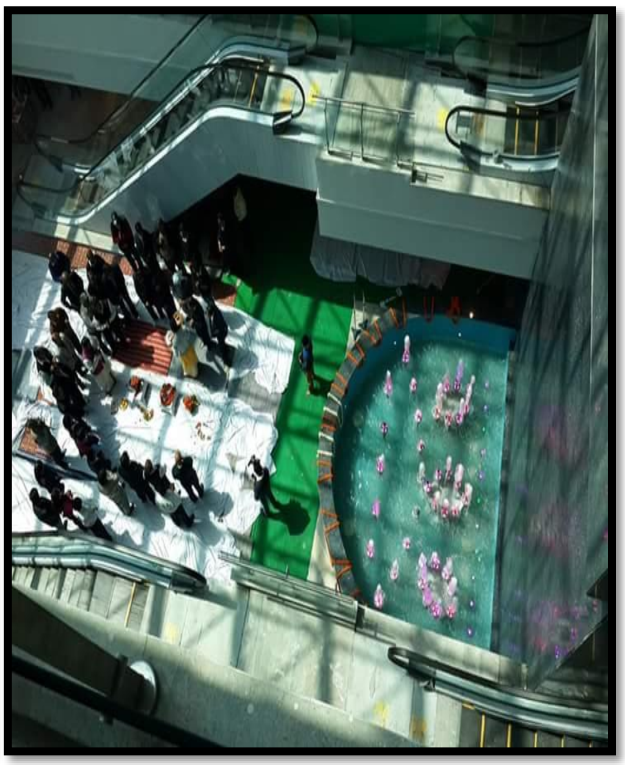


Fig. 13 Grey water and rain water are used in various purposes like fountains, flushing etc.

KEY GREEN FEATURES IMPLEMENTED IN THE SJVNL BUILDING SHIMLA.

- Energy efficient measures to conserve 15-20% of energy
- Water efficient fixtures to save water to the tune of 40-45%
- On-site rain water harvesting system
- Reuse of 100% treated waste water for landscaping and flushing requirements.
- Over 90% of the construction waste recycled and reused on the site
- Use of certified wood, jute carpets, MDF made of sugarcane bagasse
- 40% of building material is extracted and manufactured locally/ regionally.

Chapter 5

MODELLING OF GREEN HOSTEL

5.1 Hostel Plan using Auto Cad

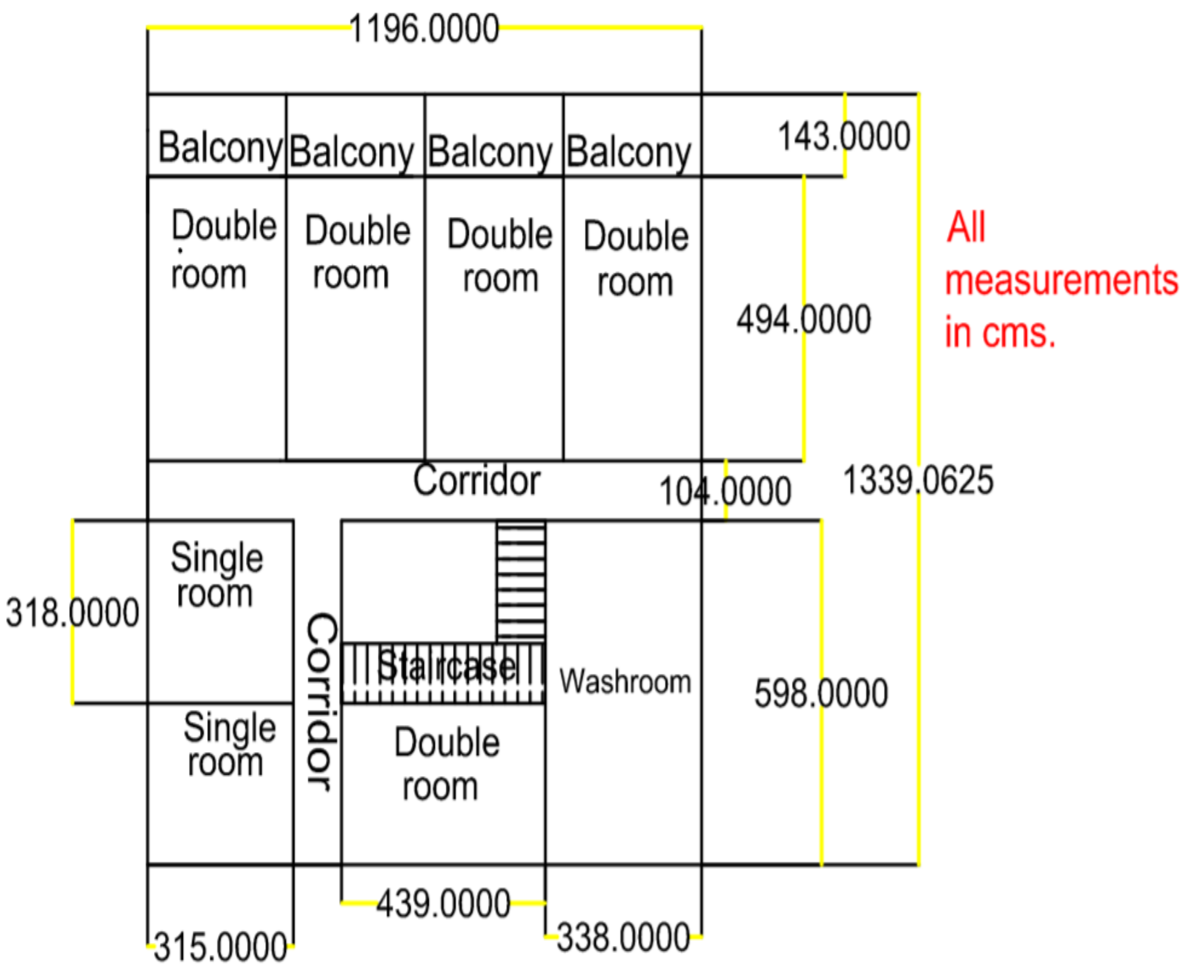


Fig 14 2D Model of Green Hostel

5.2 2D FACES OF THE GREEN HOSTEL

Fig 15 South Face of The Building

Fig 16 North Face of the Building

Fig.17 east face of the building

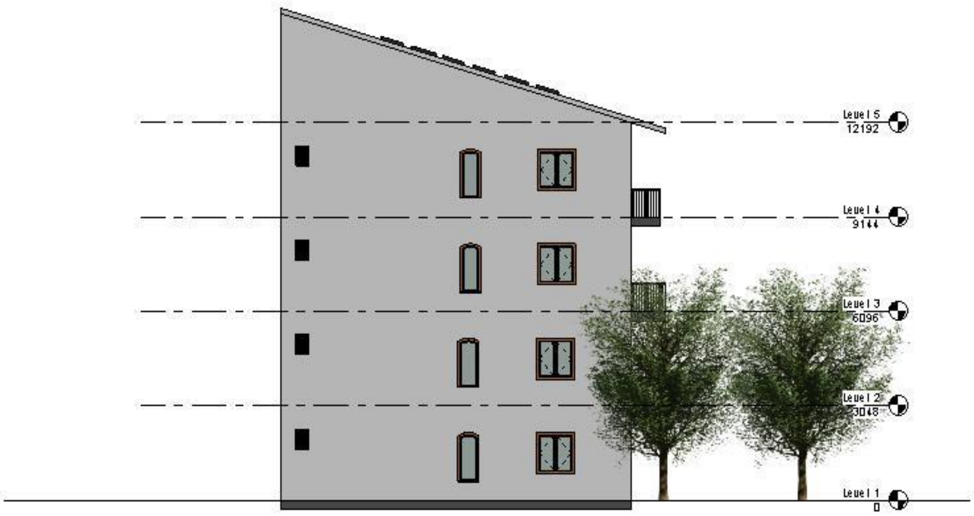


Fig 17 West Face of the Building

ABOUT THE BUILDING

As maximum amount of sunlight is received by the south facing side, we have provided maximum amount of windows and rooms in the south face of the hostel building. This allows maximum utilization of daylight so that electricity usage is minimized. Similarly minimum windows have been provided on the other three faces so as to minimize heat loss. Bathroom has been provided in the north direction where daylight is not needed. Skylight has been provided on the roof so that daylight can be used to illuminate area occupied by the staircase.

Deciduous trees have been provided around the eastern and south face of the building. This provides two benefits:

1. They shed their leaves allowing sun rays to enter the building

2. During summers green leaves don't allow sunlight to directly enter the rooms preventing heat increase.

Balcony (chajja) has been provided on every floor except the basement so as to provide a balcony as well to help in getting shade during summers when the sun is directly above the building.

Fig19. 3D View of the Hostel

5.3 SUN PATH ANALYSIS

Sun path orientation at different timings of the day to analyses the position of sun and then adjusting the orientation of windows and doors and also the design of fenestration accordingly to cut off the direct glare of sun during summers and allowing sunlight during winter season. We have taken 21st June, the biggest day of summer season and 21st December, shortest day to study the sun path during winter season.

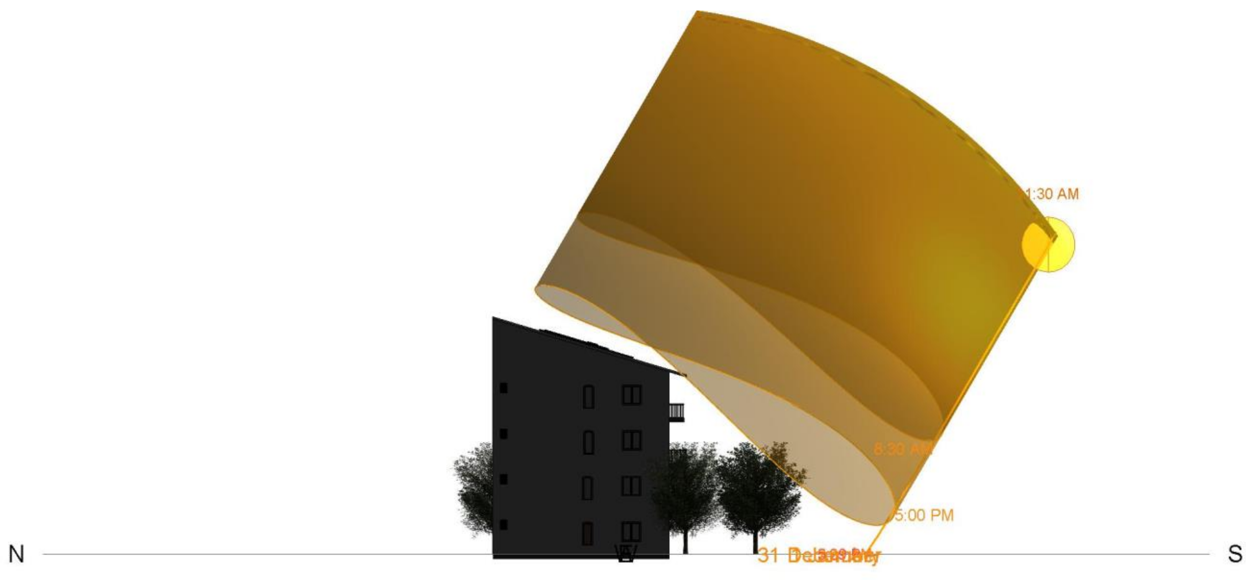


Fig.20 Elevation difference between winter and summer sun

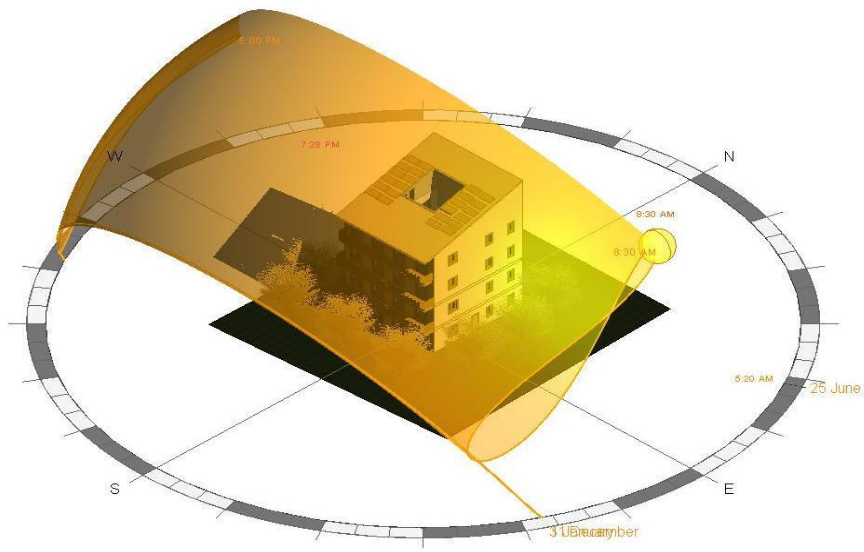


Fig.21 Daylight at 8:30 Am For Summers

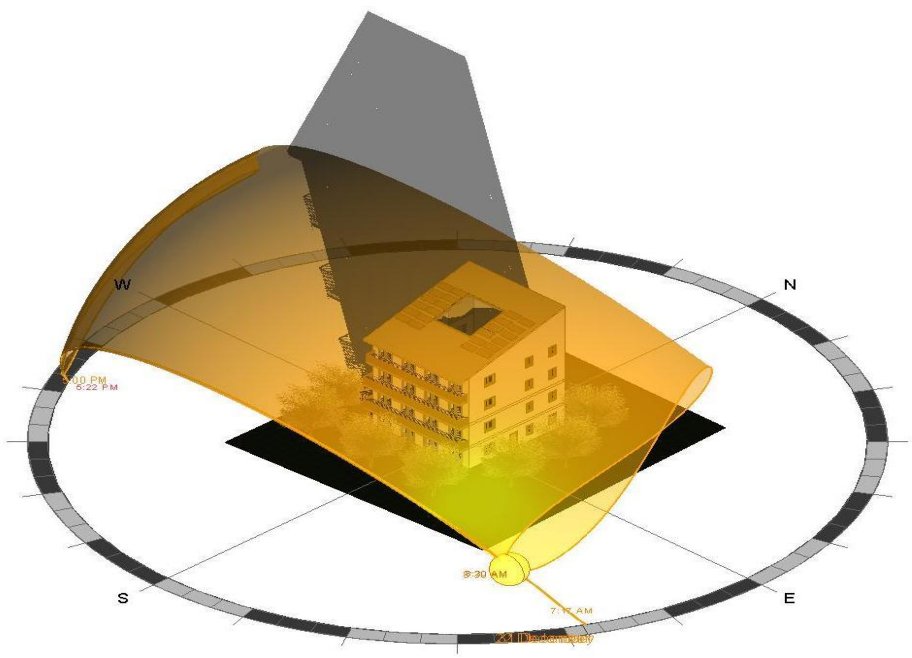


Fig.22 Day Light at 8:30 AM For Winters

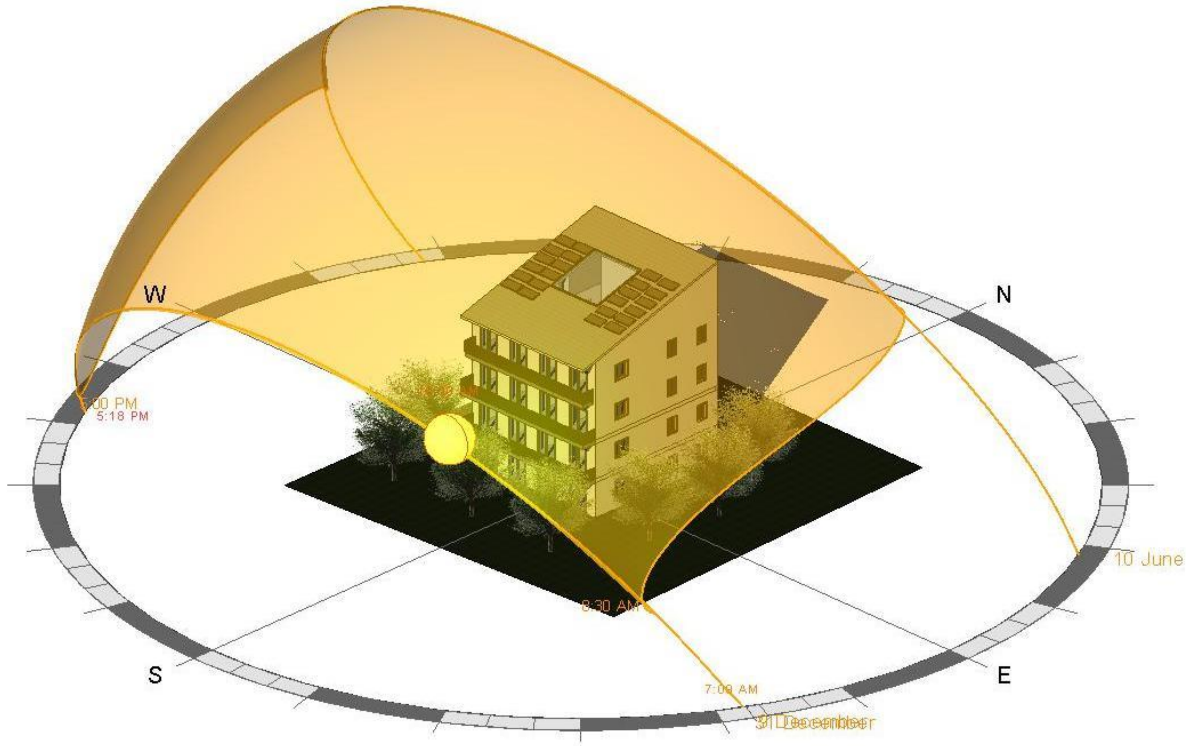


Fig.23 Day Light for winters at 10:30 AM

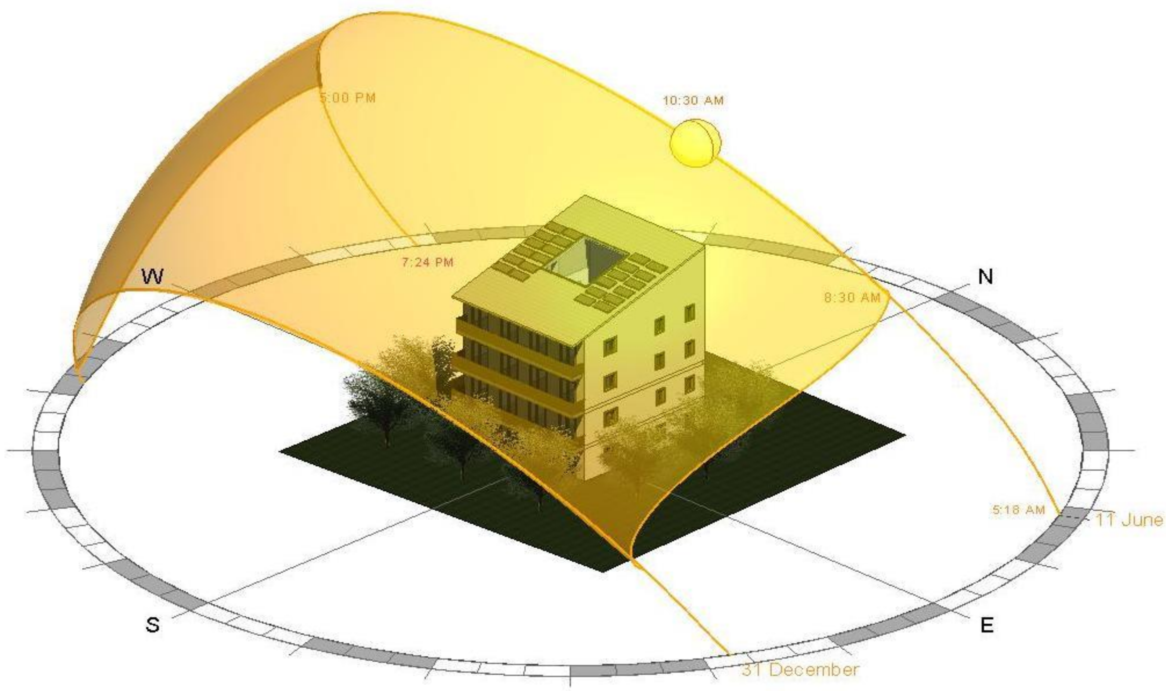


Fig.24 Day Light for Summer at 10:30 AM

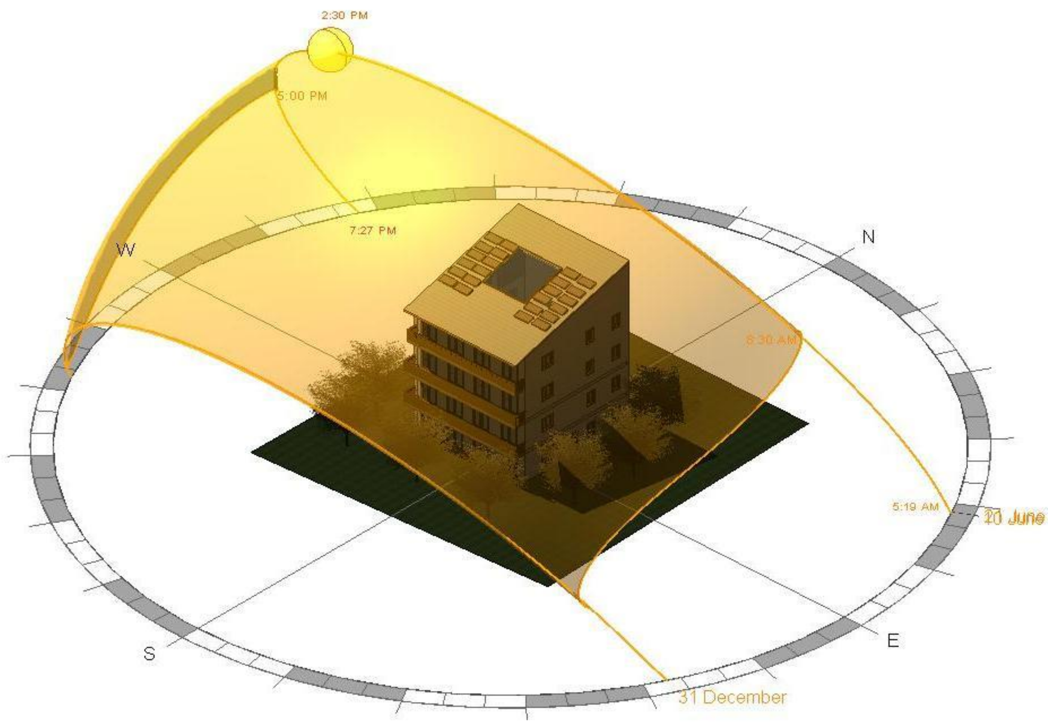


Fig.25 Day Light for Summers at 2:30 PM

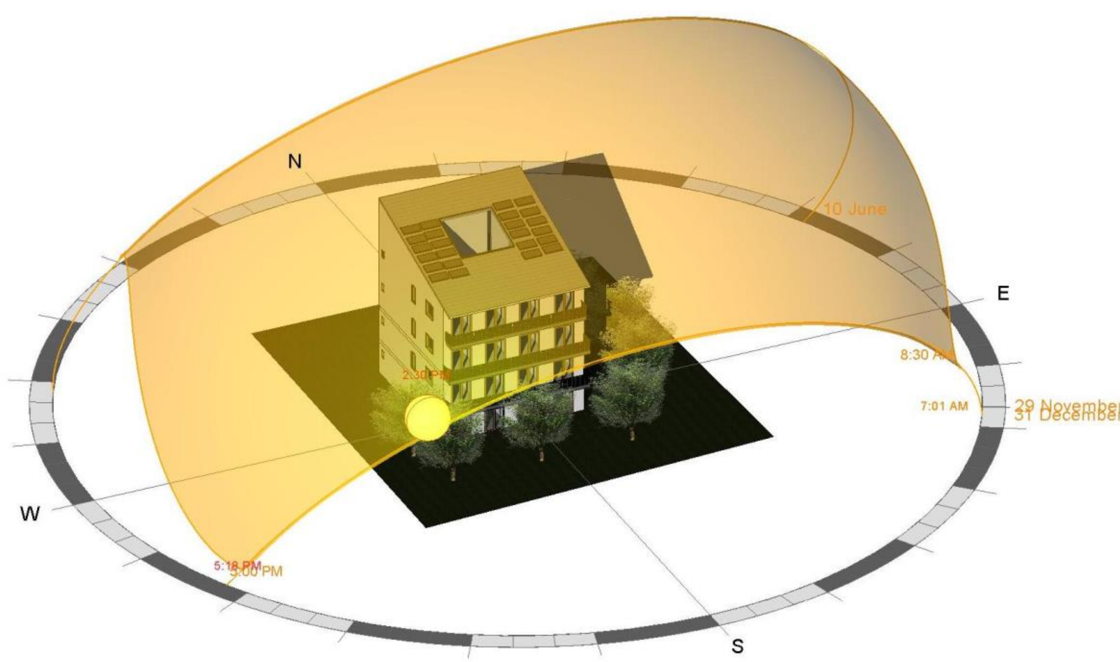


Fig.26 Day Light for Winters at 2:30 PM

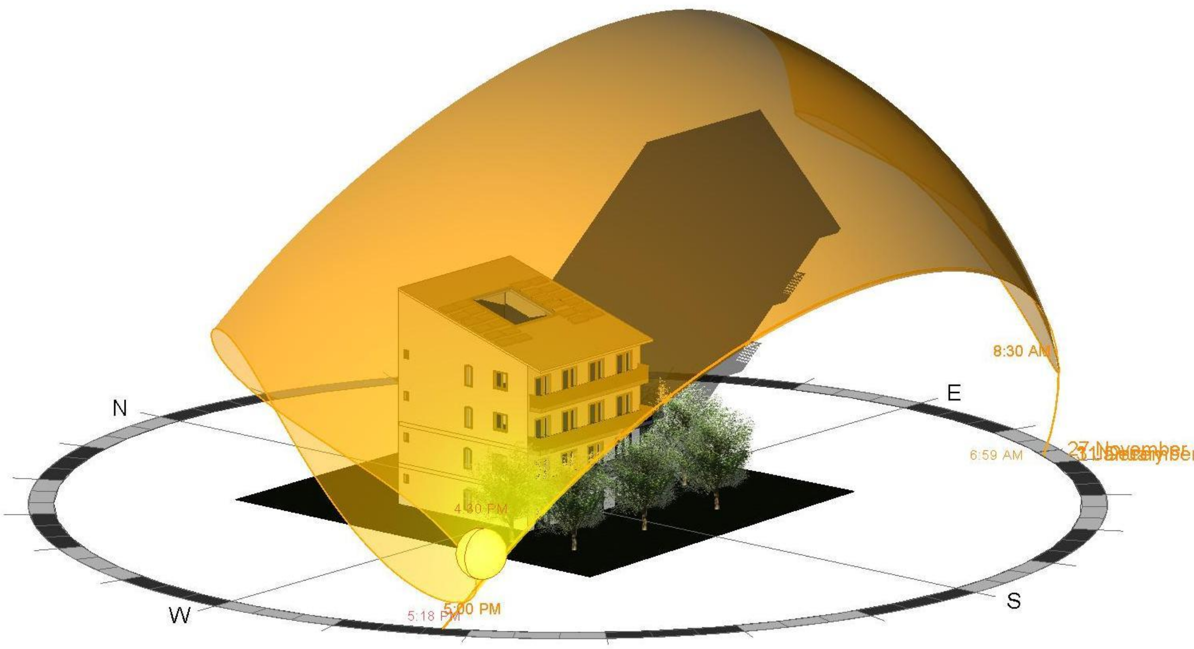


Fig.27 Day Light for winters at 4:30 PM

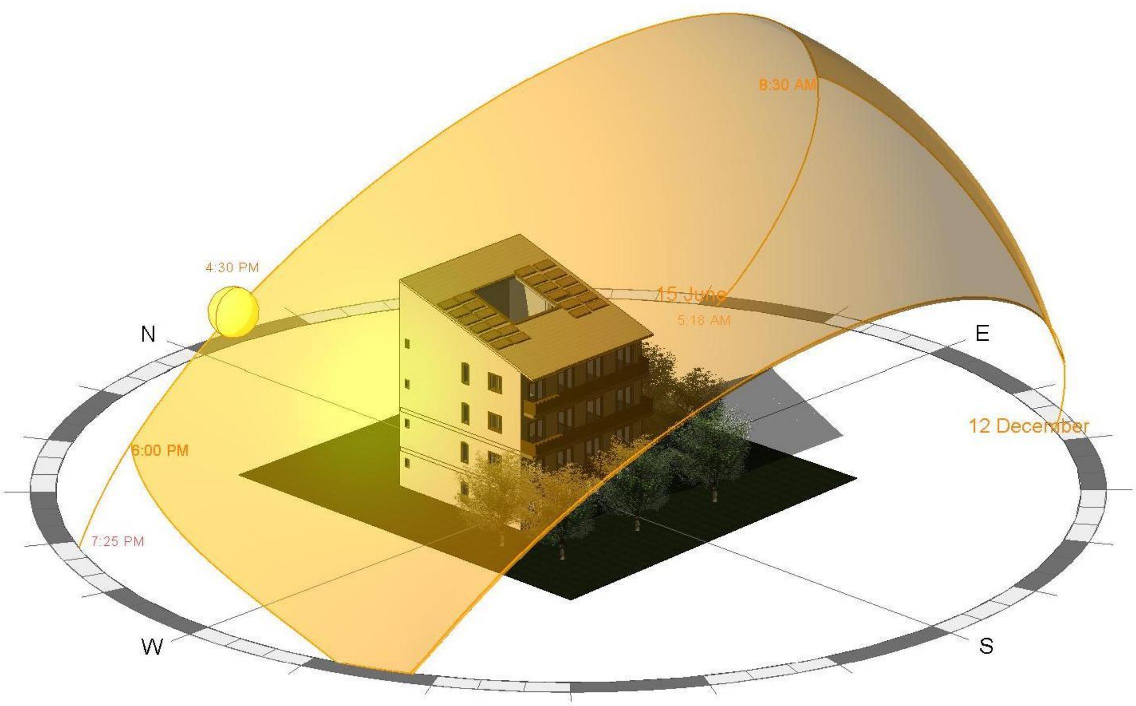


Fig.28 Day Light for summers at 4:30 PM

CHAPTER-6

COMPARISON OF CONVENTIONAL BUILDING AND GREEN BUILDING

6.1 MANUAL CALCULATIONS

Table 1 Appliance ratings and estimate usage time during a day

APPLIANCE	RATING (WATT)	ESTIMATE USAGE TIME (HOURS)
LED TUBELIGHT	36	12
FAN	70	12
SOCKET (6AMPERE)	60	8-10
SOCKET (16AMPERE)	500	4-5
EXHAUST	60	5-6
SMALL CORRIDOR LIGHTS	18	12

NOTE-In this table Rating and estimated usage time of all the appliances is mentioned.

FORMULA USED TO CALCULATE UNITS CONSUMED

- Watts per day:

  Unit wattage × no. of hours appliance used= watts per day

- Convert into kilowatts:

  Watts per day/1000=kWh per day

- 1 unit= 1kWh

Table 2 Units of electricity consumed by a single appliance on the basis of their usage time.

APPLIANCE	**UNITS CONSUMED**
LED TUBELIGHT	0.432
FAN	0.84
SOCKET (6AMPERE)	0.24
SOCKET (16AMPERE)	2.0
EXHAUST	0.36
SMALL CORRIDOR LIGHTS	0.216

DETAILS OF THE HOSTEL (H-9) TO BE DESIGNED

- Number of single rooms on each floor-3
- Number of double rooms on each floor-4
- Washroom-1

Table 3 single room (units consumed per day and number of appliances)

APPLIANCE	NUMBER OF APPLIANCE	UNITS USED
LED TUBELIGHT	1	0.432
FAN	1	0.84
SOCKET (6AMPERE)	1	0.24
SOCKET (16AMPERE)	1	2

Table 4 double room (units consumed per day and number of appliances)

APPLIANCE	NUMBER OF APPLIANCE	UNITS USED
LED TUBELIGHT	2	0.864
FAN	1	0.84
SOCKET (6AMPERE)	2	0.48
SOCKET (16AMPERE)	2	4

Table 5 washroom (units consumed per day and number of appliances)

APPLIANCE	NUMBER OF APPLIANCE	UNITS USED
LED TUBELIGHT	2	0.864
SMALL CORRIDOR LIGHT	4	0.864
EXHAUST	2	0.72

Table 6 corridor (units consumed per day and number of appliances)

APPLIANCE	NUMBER OF APPLIANCE	UNITS USED
SMALL CORRIDOR LIGHT	4	0.864

ENERGY CONSUMPTION OF A SINGLE FLOOR PER DAY

FORMULA=Units consumed by each room × no. of rooms

3.512×3=10.536units (single room)

6.184×4=24.736units (double room)

2.880×1=2.880units (washroom)

0.864×1=0.864units (corridor)

Hence total consumption=10.536units+24.736units+2.880units+0.864units=39.016units

Efficiency of the system=80%

Therefore total consumption of a single floor=0.8x39.016=31.2128units

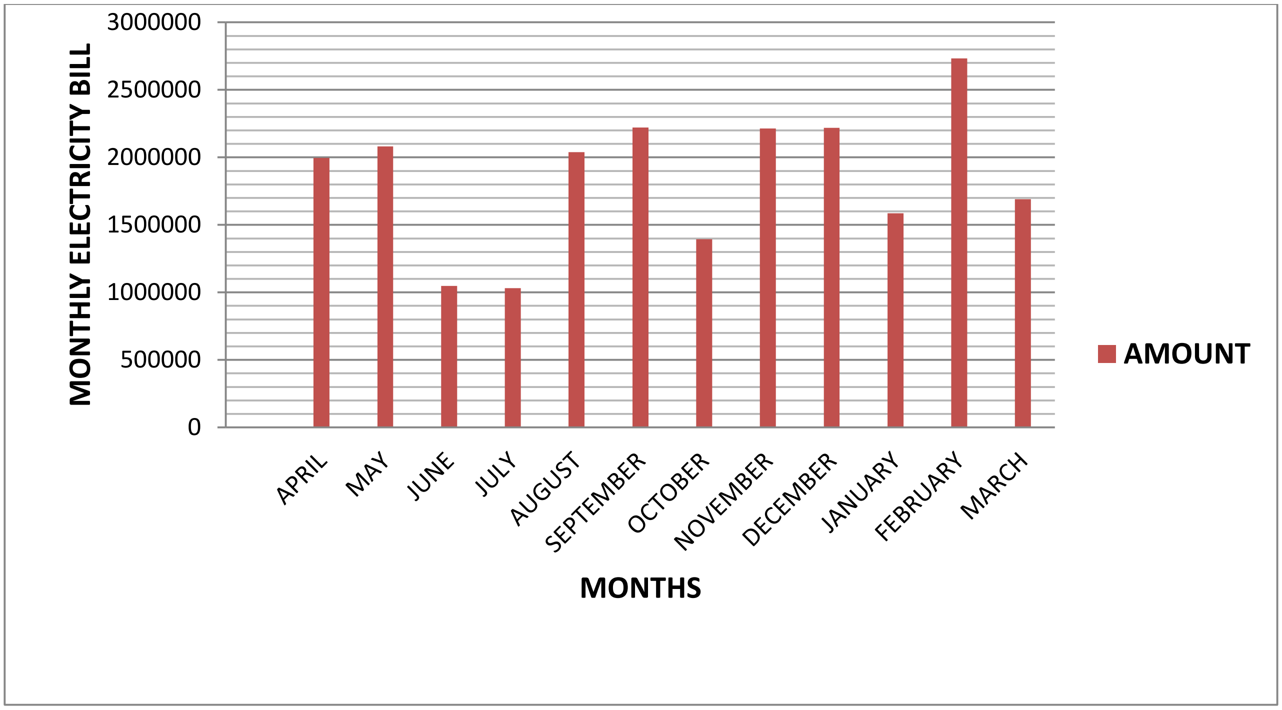


Fig. 29 Monthly electricity bill of JUIT campus

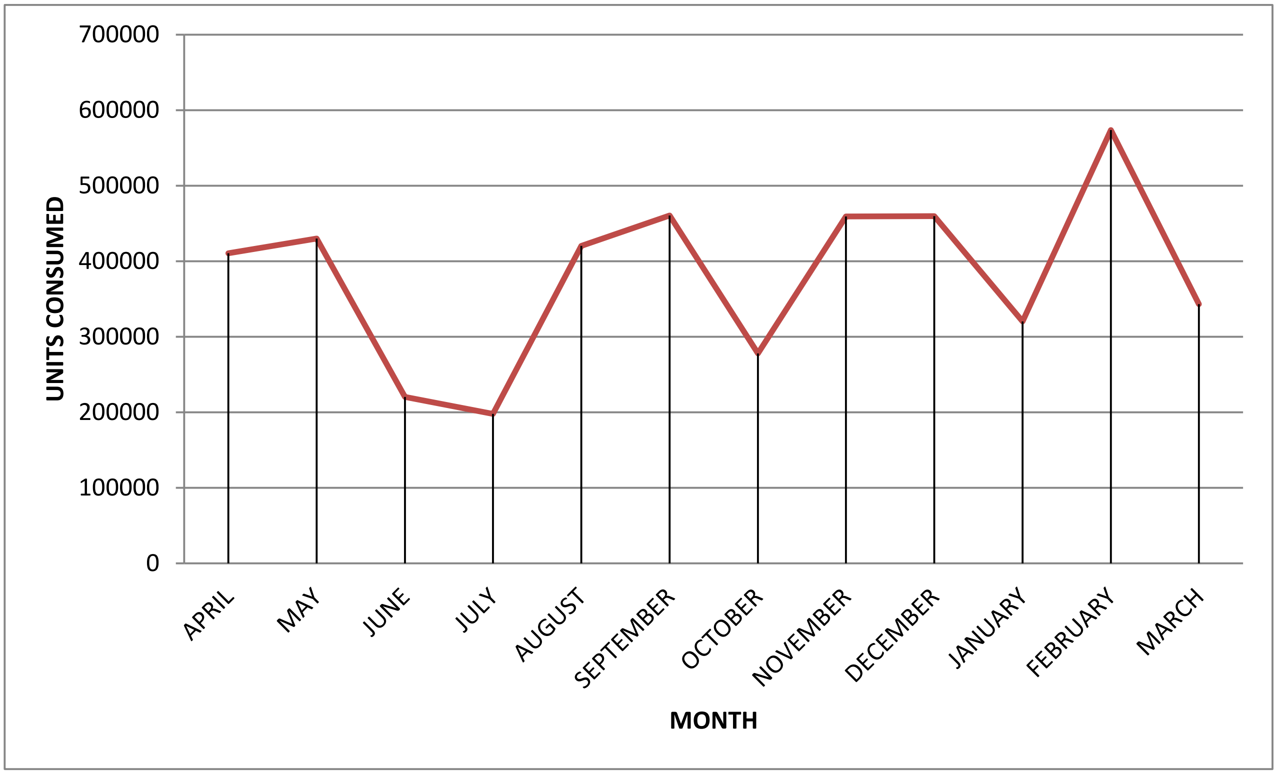


Fig. 30 Monthly units consumed by JUIT

6.5 DETAILS OF THE HOSTEL (H-9) TO BE DESIGNED(Cont.)

- Energy consumption of 5 floors per day= 31.2128×5= 156.064 units

Therefore, monthly consumption = 156.064×30= 4681.92 units

- Now 1 KW system produces 4 units of electricity everyday.Therefore we need a system of 156.064/4= 44 KW system
- Now 1 KW system costs 1.5 lacs with batteries.Therefore 44 KW system costs 44*1.5= 66 lacs.

Now JUIT comes under the category of commercial building whose unit rate varies from Rs. 4.76 to 6 per unit.

Table 7 Cost Analysis

UNIT RATE	MONTHLY COST	RECOVERY TIME(MONTHS)	RECOVERY TIME(YEARS)	SAVINGS
4.76	4681.92*4.76=22285	6600000/22285=296.16	296.16/12=25	5*12*22285= 1337100
6.00	4681.92*6=28091.52	6600000/28091.52=235	235/12=20	10*12*28091.5 = 3370980

Taking Rs. 5 per unit for 4681.92 units, it equals Rs. 23410 per month

So the cost can be covered in 6600000/23410=281 months= 23 years

The expected life of solar system is 30 years, so we save 23410*12*7= Rs. 1966440

Annual savings

100% conventional supply	***100% solar operated***	***50% solar and 50% conventional***
Cost = monthly units consumed x unit rate x 12 = 4682 x 5 x 12 = **₹ 2,80,920**	Installation cost = **₹ 2,20,000**	Cost = (2,80,920+2,20,000)/2= **₹ 2,50,460**

Chapter-7

Results of Revit analysis

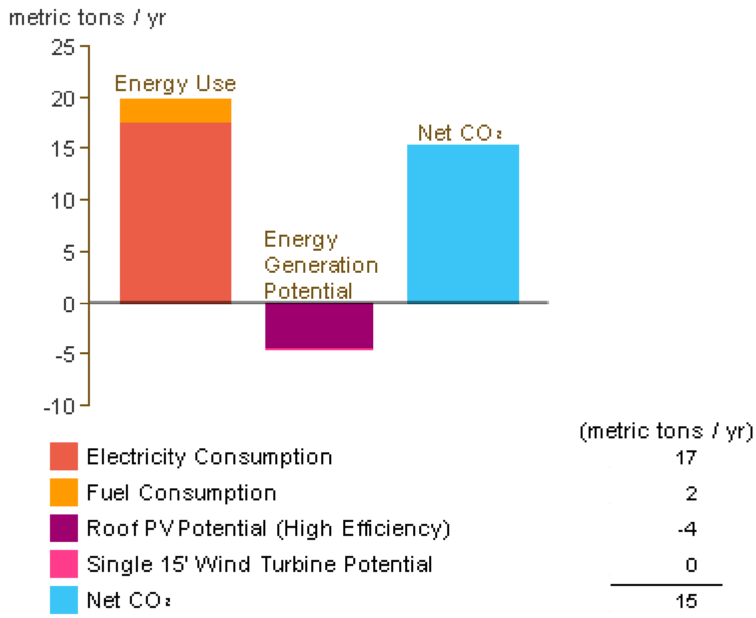


Fig 31 1.Annual Carbon Emissions

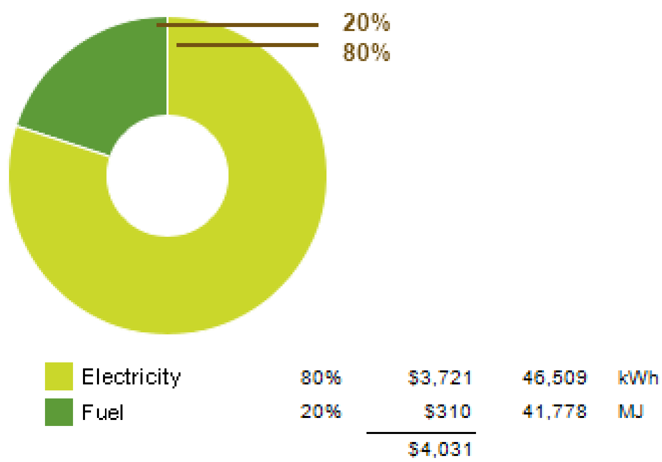
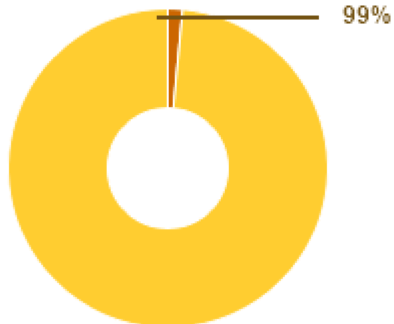
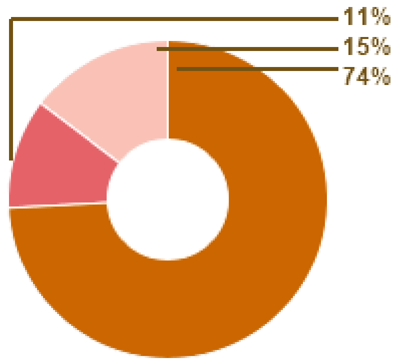


Fig 32. Annual Energy Use/Cost



			(MJ)
HVAC	1%	$4	623
Domestic Hot Water	99%	$305	41,155
		$309	41,778

Fig 33. Energy Use: Fuel



			(kWh)
HVAC	74%	$2,758	34,485
Lighting	11%	$414	5,181
Misc Equipment	15%	$547	6,842
		$3,719	46,508

Fig34. Energy Use: Electricity

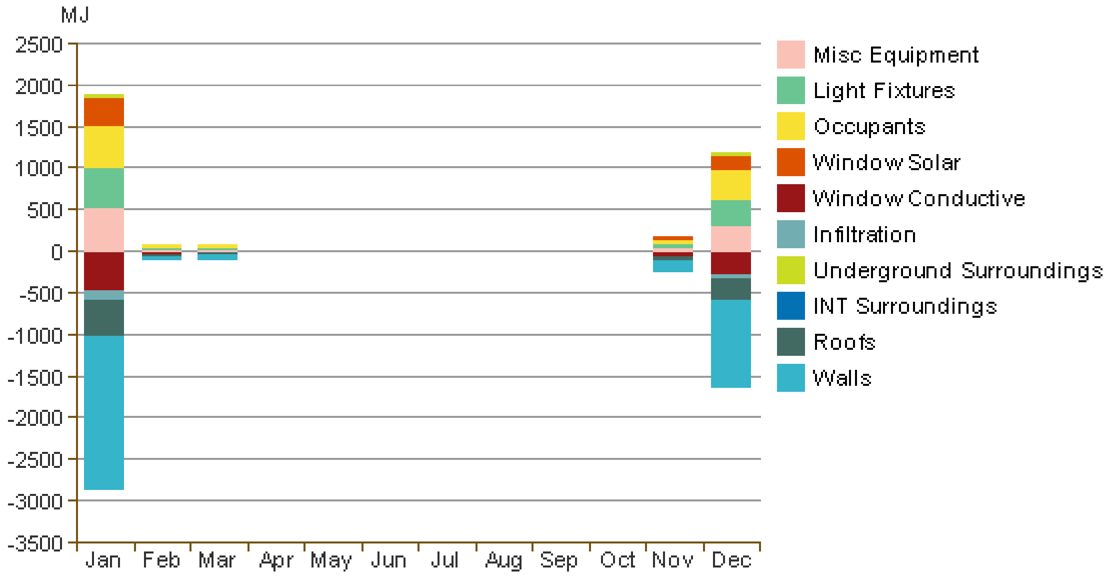


Fig35. Monthly Heating Load

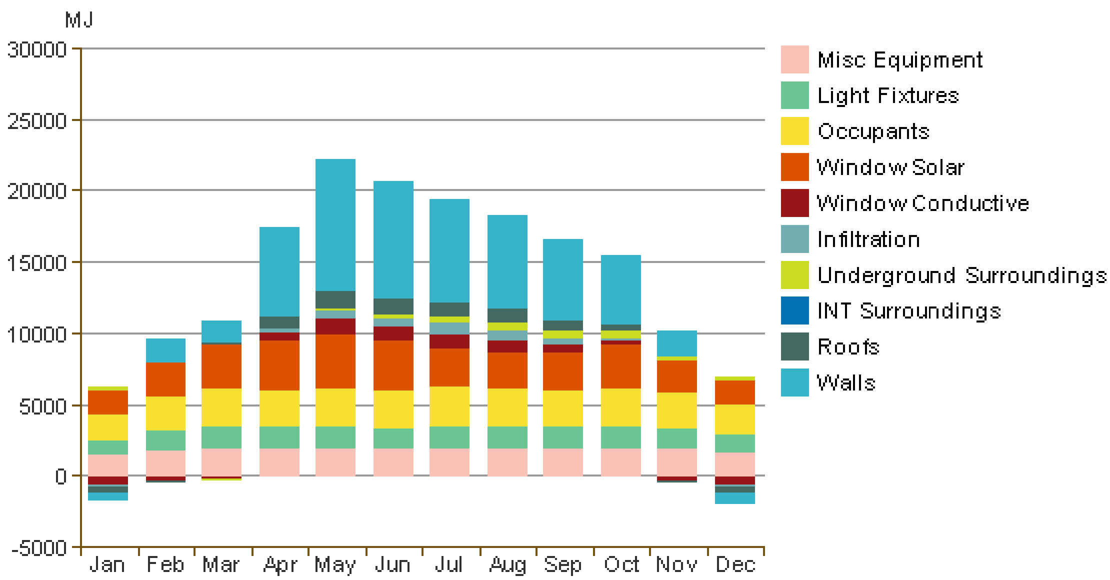


Fig36. Monthly Cooling Load

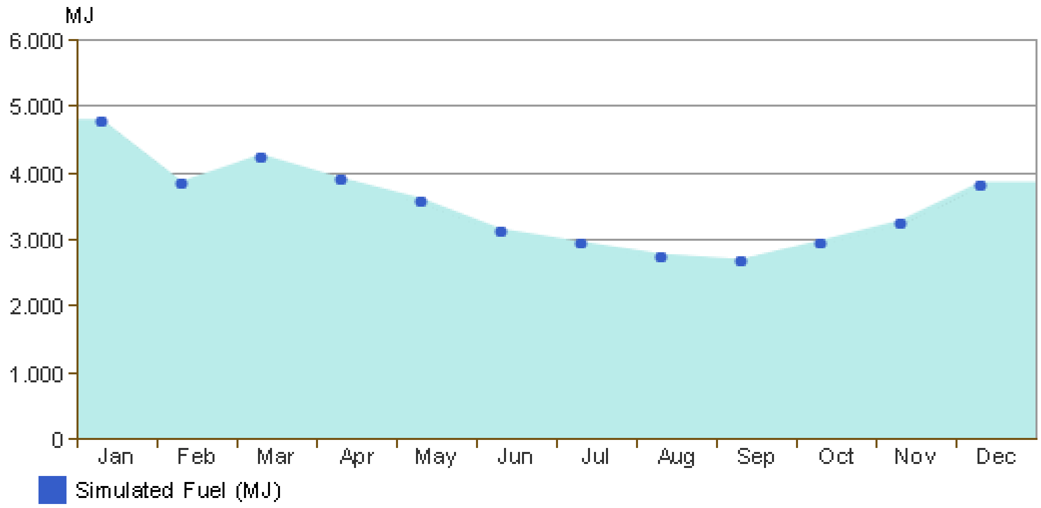


Fig37.Monthly Fuel Consumption

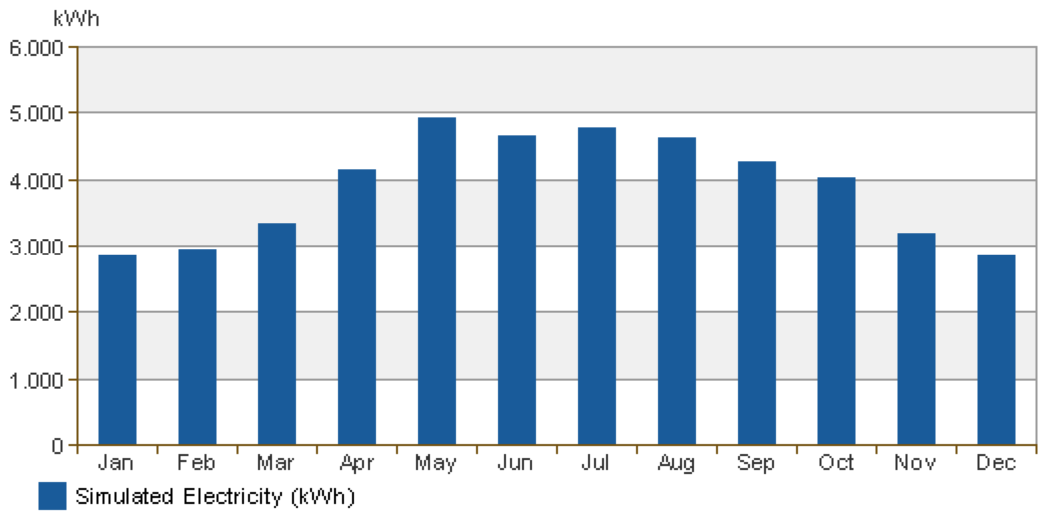


Fig38.Monthly Electricity Consumption

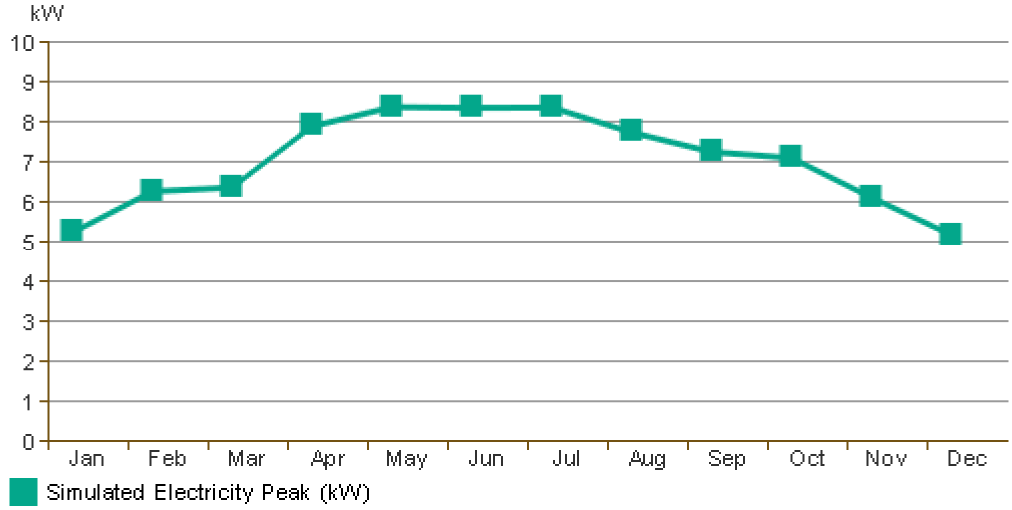


Fig39.Monthly Peak Demand

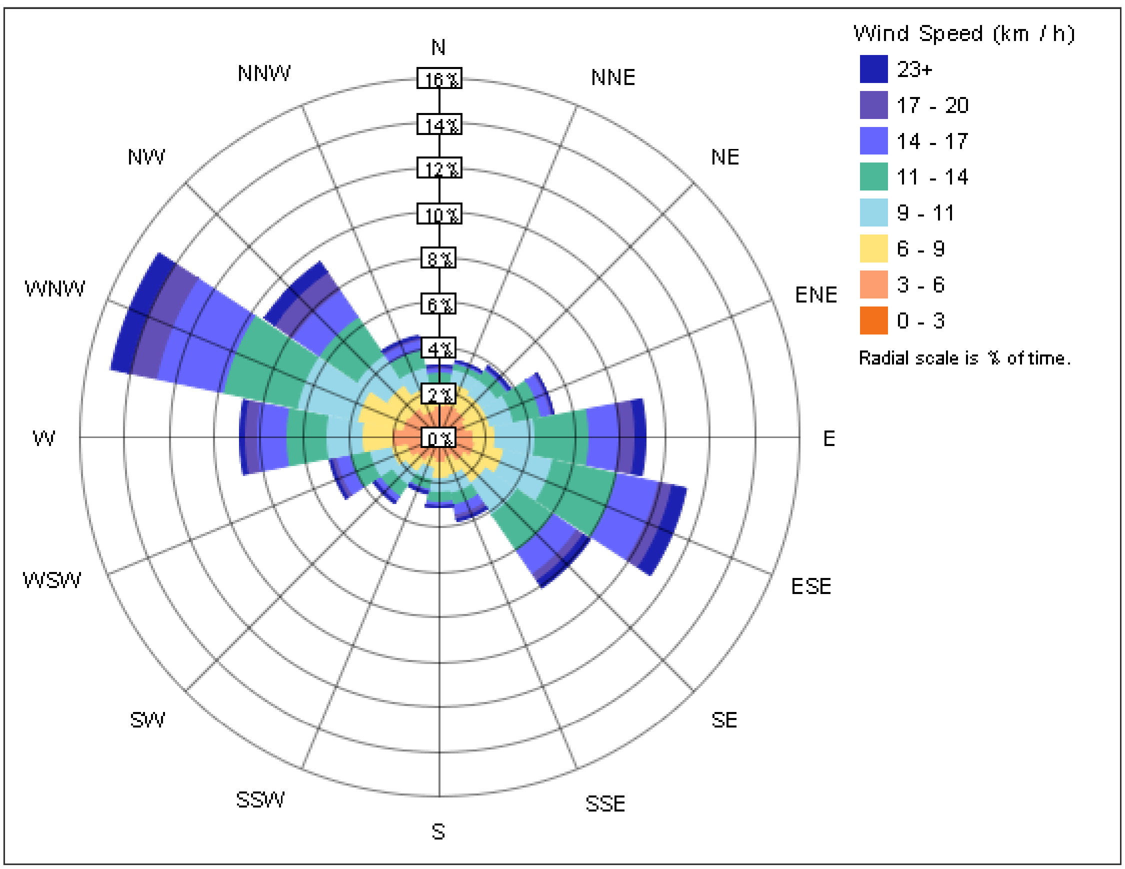


Fig40.Annual Wind Rose (Speed Distribution)

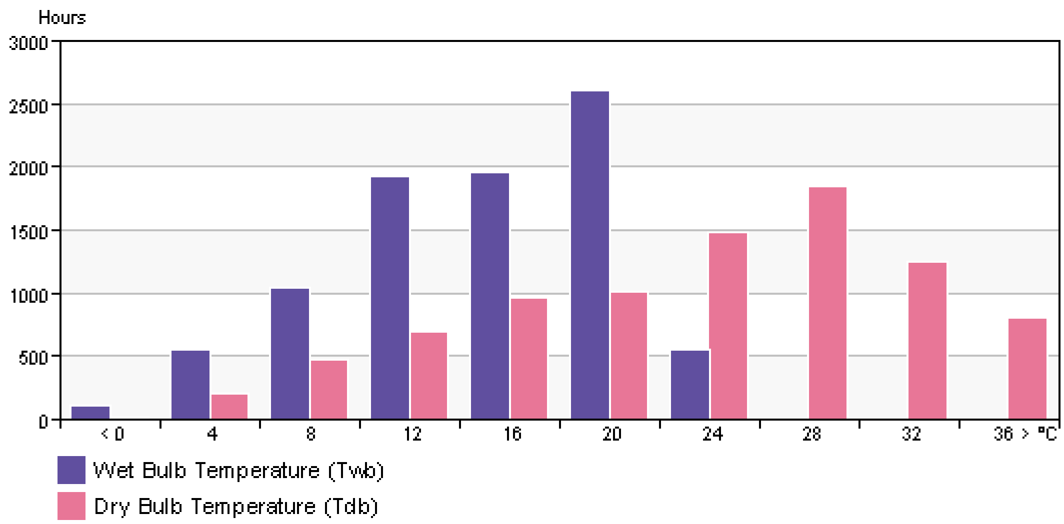


Fig41.Annual Temperature Bins

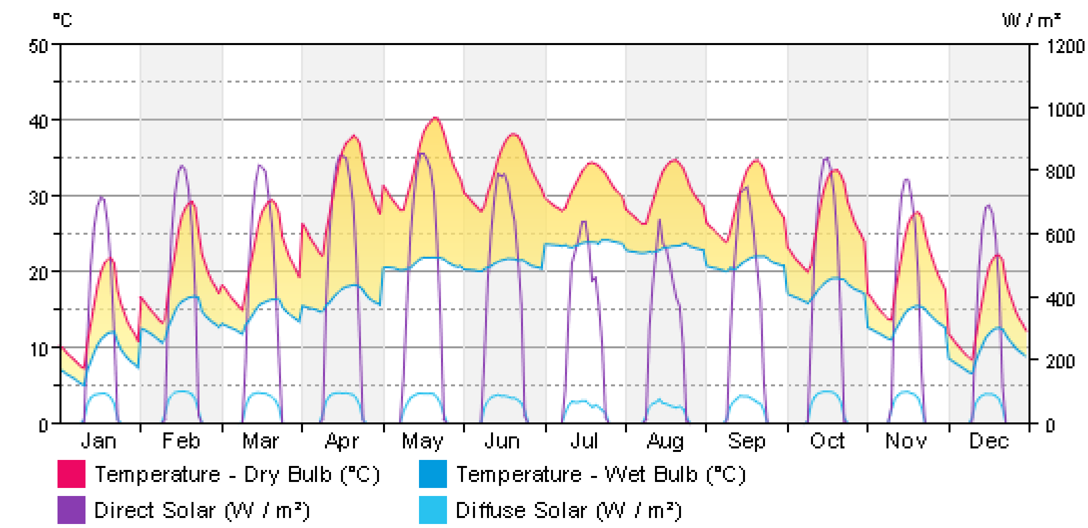


Fig42.Diurnal Weather Averages

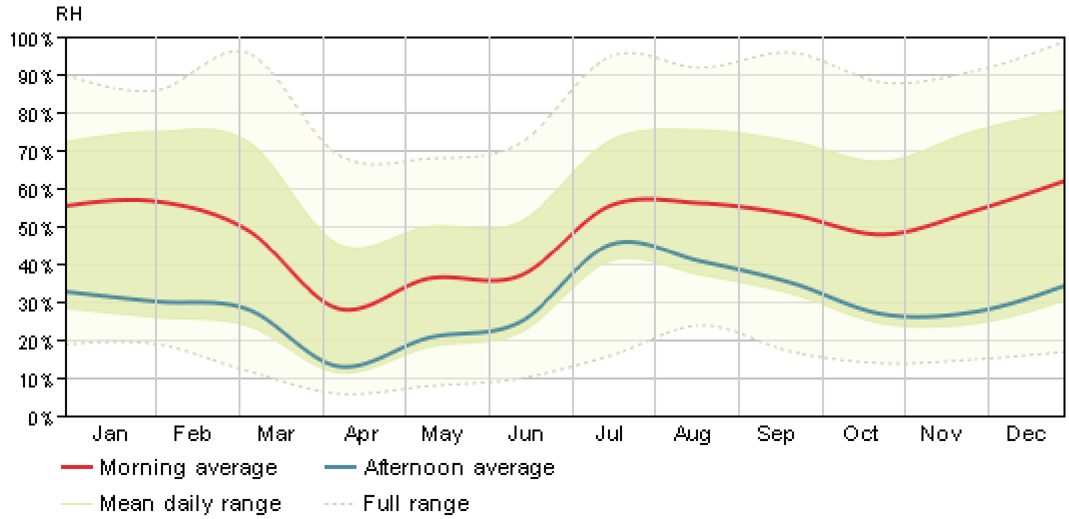


Fig 43.Humidity

CHAPTER 8

CONCLUSION

Green buildings are planned to diminish the overall impact of the built environment on human health and the natural exhaustible resources. In order to minimize daylight penetration into the interior in summers, light shelves was provided above the windows and also designed for integration of day lighting and to cut off direct radiation.

For insulation of walls rock wool insulation is used, sun path analysis for daylight orientation is done, tropical skylight on the roof was constructed for ventilation and light in the central part of the building especially for staircase area.

On preparing the 3D model of green building we have analyzed various parameters like carbon dioxide emissions, electricity consumption, etc. On taking 100% electricity by solar panels, the cost recovery period comes out to be 23 years.Hence the total savings upto 30 years comes to be Rs 1966440.

This energy analysis was carried out with the help of REVIT which makes it easy to properly study the details and then analyzing at the same time. The structure of the building is prepared keeping in mind the external conditions such as the location, geographical parameters, weather, temperature, sunlight intensity and duration.

FUTURE SCOPE

Energy analysis can be done by other software as well such as Insight, Green building Studio. Many others techniques apart from the one used in this project like rain water harvesting technique, green roofing, various other insulating materials, glasses can also be incorporated in green buildings. The construction practice will be different for places with different geographical conditions and have to be carried out accordingly.

REFERENCES

1. Majumdar, M. (2001). Energy efficient buildings in India: The Energy and Resources Institute (TERI).

2. Kamel, B., Wahba, S., Nassar, K., and Abdelsalam, A. (2012) Effectiveness of Green-Building
3. Roof on Reducing Energy Consumption through Simulation Program for a Residential Building: Cairo, Egypt. Construction Research Congress 2012: pp. 1740-1749.

4. Kang, Y., Kim, C., Son, H., Lee, S., and Limsawasd, C. (2013). ”Comparison of Preproject Planning for Green and Conventional Buildings.” *J. Constr. Eng. Manage.*, 139(11), 04013018(1-9)

5. Ariosto, T. and Memari, A. (2013) Comparative Study of Energy Efficiency of Glazing Systems for Residential and Commercial Buildings. AEI 2013: pp. 409-418

6. Kang, Y., Kim, C., Son, H., Lee, S., and Limsawasd, C. (2013). "Comparison of Preproject Planning for Green and Conventional Buildings." *J. Constr. Eng. Manage.*, 10.1061/(ASCE)CO.1943-7862.0000760, 04013018

7. S. Fereidoon , “Ministry of New and Renewable Energy”, Green stream.