Cost Benefit of Green Building Effective Planning of Construction According To Region

Prof.A.R.Vasatkar[1],Miss.Jadhav Shubhangi Nivrutti[2]
[1]Assistant Professor, Dept of Civil Engineering
[2]Dept of Civil Engineering
[1, 2] JSPM's BSCOER,Pune,Maharastra,India.

Abstract- *Green buildings are characterised as those providing the required building performance over the building life-cycle whilst minimising consumption of non-renewable resources and the environmental loadings to land, air and waters. However, the assessment of new buildings covers only performance aspects from the initial planning stage through to building completion. Actual performance during building use depends on what has been achieved in terms of improved design and construction quality, as confirmed by final testing and commissioning, the quality of management, operation and maintenance practices, as well as the activities of building users.*

In this study CBA is studied for two different region with different climate condition

Keywords- Green building, effective planning, CBA

I. INTRODUCTION

1.1 General

Cost–benefit analysis (**CBA**), sometimes called **benefit costs analysis** (**BCA**), is a systematic approach to estimating the strengths and weaknesses of alternatives (for example in transactions, activities, functional business requirements or projects investments); it is used to determine options that provide the best approach to achieve benefits while preserving savings. The CBA is also defined as a systematic process for calculating and comparing benefits and costs of a decision, policy (with particular regard to government policy) or (in general) project.

Broadly, CBA has two main purposes:

- To determine if an investment/decision is sound (justification/feasibility) – verifying whether its benefits outweigh the costs, and by how much;
- To provide a basis for comparing projects – which involves comparing the total expected cost of each option against its total expected benefits.

CBA is related to (but distinct from) cost-effectiveness analysis. In CBA, benefits and costs are expressed in monetary terms, and are adjusted for the time value of money, so that all flows of benefits and flows of project costs over time (which tend to occur at different points in time) are expressed on a common basis in terms of their net present value.

Closely related, but slightly different, formal techniques include cost-effectiveness analysis, cost–utility analysis, risk–benefit analysis, economic impact analysis, fiscal impact analysis, and social return on investment (SROI) analysis.

1.2 CBA and Regulation under various US Administrations

The increased usage of CBA in the US regulatory process is often associated with President Ronald Reagan's administration. Though the use of CBA in US policy making dating back many decades, Reagan's Executive Order 12291 mandated the use of CBA in the regulatory process. Reagan campaigned on a deregulation platform, and once he took office in 1981 quickly issued this EO, which vested the Office of Information and Regulatory Affairs (OIRA) with the authority to review agency regulations and required federal agencies to produce regulatory impact analyses when the annual impact could be estimated over $100M. Shortly thereafter, in the 1980s, academic and institutional critiques of CBA started to emerge. The three main criticisms were:

- That CBA could be used for political goals. Debates on the merits of cost and benefit comparisons can be used to sidestep political or philosophical goals, rules and regulations.
- That CBA is inherently anti-regulatory, therefore not a neutral analysis tool. This is an ethical argument: that the monetization of policy impacts is an inappropriate tool for assessing things such as mortality risks and distributional impacts.

- That the length of time necessary to complete CBA can create significant delays, which can impede policy regulations.

1.3 Elements Of Green Building

There are 4 elements of Green Building. That shows the main points required to be considered while designing any building.

- Smart Design
- Energy Efficiency
- Eco Materials
- Water Conservation

1.4 Impacts Of Conventional Buildings That Green Buildings Seek To Rectify

The environmental impacts of buildings are enormous. Conventional buildings use large amounts of energy, land, water, and raw materials for their construction and operation. They are responsible for large greenhouse gas (GHG) emissions as well as emissions of other harmful air pollutants. They also generate large amounts of construction and demolition (C&D) waste and have serious impacts on plants and wildlife. An analysis of these issues demonstrates the scope of the problem.

Fig 1.1: benefits of green building

1.5Evaluation

CBA attempts to measure the positive or negative consequences of a project, which may include:

- Effects on users or participants
- Effects on non-users or non-participants
- Externality effects
- Option value or other social benefits.Over-reliance on data from past projects (often differing markedly in function or size and the skill levels of the team members)
- Use of subjective impressions in assessment
- Inappropriate use of heuristics to derive money cost of the intangible elements
- Confirmation bias among project supporters (looking for reasons to proceed).

CASE STUDY

Fig 1.2: 3rd eye view of actual site

SITE DETAILS

- Name of site : Cool homes
- Location of site : cool homes, ring road, behind gajanan maharaj mandir, bhusawal, jalgaon.
- A G+4 proposed building of 24 flats and of 4 shops is taken for case study location is inBhusawal.
- Design Team : Apex consultant
- Owner and Developer :ShivajiPatil
- Architect :SnehaNichat
- Cost of project : 2.4 cr.
- Structural Engineer :NavneetPatil and PrashantPatil
- Builder :Praj Infra Solutions pvt.ltd.
- Area : 6400 sq.feet
- Residential building having 24 flats and 4 commercial road front shops.
- This project is based on sustainable structure.
- This project using heat resisting theme building project. (In bhusawal the temperature in summer rises upto 48-49 degree celc.

Details and features of building

- New Technological AAC Bricks which has low thermal conductivity and Heat Insulated
- Thermally Insulated & Energy Efficient.
- Fire Resistant

- Non-combustible and fire resistant up to 1600° C.
- Can withstand up to 6 hours of direct exposure.

Cool Roof Technology –

A *cool roof* is a roofing system that delivers higher solar reflectance (the ability to reflect the visible, infrared and ultraviolet wavelengths of the sun, reducing heat inside your home

UV Protected Windows-

UV window films cut out 99% of *UV* rays and 79% of solar Energy and allow only Visible light to enter inside your Dream home reducing heat inside.

Admixture And Exterior Paints –

Special Type of Admixtures in plaster and Paints in exterior size to Resist heat and Keep your Dream home cool
Religious surrounding of GajananMaharajMandir.

General Specifications

Seismic Zone II compliant RCC framed structure
Internal & external walls as per the structural requirement
Basement parking
Designed for IGBC Green Homes Gold Certification
Reticulated piped gas system in kitchen
Water treatment plant
Rainwater harvesting
Sewage treatment plant
Organic waste converter system

II. LITERATURE REVIEW

Nushrat Shabrin, 2 Saad Bin Abul Kashem 'A Comprehensive Cost Benefit Analysis Of Green Building'volume-4, Issue-2, Aprl.-2017:

Nowadays green building has high impact in society. Now designers understand that fresh air, improved indoor environment, and water savings is also important. Green building is well-known because of its environmental benefit, In this report economic and social benefit of green building has been discussed. Aspects of green building around the world have been discussed. Strength, weaknesses, opportunity and threat (SWOT) analysis, Life-cycle cost calculation for green building was done on a projected green building. In economic analysis, the total monetary cost and non-monetary cost are counted together as one in order to know the residual accrues to the government. The findings of this study are similar to those in other countries, in most of which the excess cost of the green building was estimated at 0–10%.

Executive Summary 'Cost-Benefit Analysis and the Environment' ISBN 92-64-01004-1,OECD 2006:

The OECD has long championed efficient decision-making using economic analysis. It was, for example, one of the main sponsors of the early manuals in the late 1960s on project evaluation authored by Ian Little and James Mirrlees.* Since then, cost-benefit analysis has been widely practised, notably in the fields of environmental policy, transport planning, and healthcare. In the last decade or so, cost-benefit analysis has been substantially developed both in terms of the underlying theory and in terms of sophisticated applications. Many of those developments have been generated by the special challenges that environmental problems and environmental policy pose for cost-benefit analysis. The OECD has therefore returned to the subject in this new and comprehensive volume that brings analysts and decision-makers up to date on the main developments.

Väinö Nurmi1, Athanasios Votsis, Adriaan Perrels, Susanna Lehvävirta 'Cost-benefit analysis of green roofs in urban areas: case study in Helsinki' 2013"

This report presents a green roof cost-benefit analysis. Green roofs are roofs that are partially (or almost completely) covered with vegetation; between the roofing membrane and the vegetation there may be several technical layers. In this report we discuss the benefits and costs of lightweight self-sustaining vegetated roofs that do not require structural modifications from the building. The costs and benefits have been analysed in Helsinki, Finland. Green roofs offer various kinds of ecosystem services that are often scarce especially urban areas. These services accrue benefits to urbanites. However, ecosystem services do not generally have a market price, thus we had to use ecosystem valuation methods to estimate the benefits. Based on the valuation, the most significant benefits were: an increased lifespan of the roof, energy savings due to increased isolation and cooling, improved storm-water management, better air-quality and sound insulation especially in the air craft noise zones. In addition, other potentially significant benefits include aesthetic benefits, health benefits and improved biodiversity. Only a share of the green roof benefits accrues to the owner of the property while other benefits are distributed among the population of a larger area. Thus, benefits can be classified into private and public benefits. In the cost-benefit analysis we found that private benefits are in most cases not high enough to justify the expensive investment of a green roof instalment since the costs are incurred solely by the private decision

makers (e.g. developers, real estate buyers). The cost estimates are based on supplier interviews and the additional costs of green roof were compared to a reference bitumen roof. The cost-benefit calculations hint that with a higher rate of implementation and realization of public benefits, the green roofs would be a good investment. However, because the private benefits are not high enough to justify a green-roof installation for a private decision-maker at the current cost level, the rate of implementation can be expected to stay low without corrective policy instruments. Policy instruments could include supportive policies that add incentives for private decision-makers to install green roofs and/or administrative orders.

Anna Furberg, Sverker Molander, Holger Wallbaum 'Sustainability Assessment of Transport Infrastructures' 2014:

Purpose The purpose of this study was to identify the current best practices in sustainability assessment of transport infrastructures. This identification should further lead to the establishment of information regarding existing issues and knowledge gaps in the practice of sustainability assessment of transport infrastructures. The results from the study should also provide a foundation for a research project proposal. That is, a proposal for collaboration between Norwegian Public Roads Administration (NPRA) and Chalmers University of Technology in connection to sustainability assessment of transport infrastructures. Method Information about practices in sustainability assessment of transport infrastructures together with information about attempts to improve these practices was gathered through a literature review. Further, the review also enabled identification of issues and knowledge gaps connected to sustainability assessment of transport infrastructures acknowledged in academic literature. The review targeted the terms "sustainability assessment", "transport", "infrastructure", "road" and "strategic environmental assessment" and was limited to literature published around the years of 2000 to 2014. Results and discussion There are many on-going practices in sustainability assessments of transport infrastructures around the world, although the practices vary in effectiveness. Environmental impact assessment (EIA), Strategic environmental assessment (SEA), Costbenefit analysis (CBA), Multi-criteria analysis (MCA) and Life-cycle analysis (LCA) are all examples of methodologies that are used and CBA, MCA and LCA can also be incorporated in the procedures of EIA and SEA. In several countries there exist legal frameworks for sustainability assessment of transport infrastructures, like in the European countries through the EIA and SEA Directives. SEA acknowledges limitations of EIA and introduces wider perspectives to consider sustainability aspects more properly. However, sustainability assessment of transport infrastructures performed with SEA that considers sustainability aspects sufficiently and realizes strategic planning of these complex systems, seems to be at its infancy. Nevertheless, there do exist several studies connected to for example SEA that are reaching for improved sustainability assessments of transport infrastructures. Identified key issues and knowledge gaps are the requirement to include wider spatial and temporal scales, consider cumulative impacts and indirect effects and more effective incorporation of stakeholders. Other highlighted issues were the insufficient linkages between procedural stages in sustainability assessments, inadequate monitoring and that knowledge from other fields should be utilized further.

Bakhoum E. S., Garas G. L. and Allam M. E. 'Sustainability Analysis Of Conventional And Eco-Friendly Materials: A Step Towards Green Building' Vol. 10, No. 2, February 2015:

In the construction industry, selection of sustainable structural materials during the design phase leads to move towards more sustainable construction. Therefore, there is a need to select more green building materials to be used in construction. Based on the promising vision of future needs for sustainable development this paper presents a comparative study between conventional and eco-friendly building materials using sustainability measures. A prototype of two storeys was constructed using eco- friendly building materials (integrated bricks, rice straw bales, M2 system, plain concrete, and Rockwool sandwich panels). A sustainable decision support system (SDSS) was used to compare between the structural building materials of the two structural systems. The results showed that the eco-friendly system had better sustainability rank (67%) than the conventional system (56%). In addition, the results of SDSS showed that the Eco-friendly system was better than the conventional system during the three phases of total life.

Greg Kats, Capital E 'The Costs and Financial Benefits of Green Buildings' October 3, 2003:

Integrating "sustainable" or "green" building practices into the construction of state buildings is a solid financial investment. In the most comprehensive analysis of the financial costs and benefits of green building conducted to date, this report finds that an upfront investment of less than two percent of construction costs yields life cycle savings of over ten times the initial investment. For example, an initial upfront investment of up to $100,000 to incorporate green building features into a $5 million project would result in a savings of at least $1 million over the life of the building,

assumed conservatively to be 20 years.1 The financial benefits of green buildings include lower energy, waste disposal, and water costs, lower environmental and emissions costs, lower operations and maintenance costs, and savings from increased productivity and health. These benefits range from being fairly predictable (energy, waste, and water savings) to relatively uncertain (productivity/health benefits). Energy and water savings can be predicted with reasonable precision, measured, and monitored over time. In contrast, productivity and health gains are much less precisely understood and far harder to predict with accuracy. There is now a very large body of research, reviewed in this report, which demonstrates significant and causal.

Davide Astiaso Garcia, Fabrizio Cumo, Mariagrazia Tiberi, Valentina Sforzini and Giuseppe Piras 'Cost-Benefit Analysis for Energy Management in Public Buildings: Four Italian Case Studies' Doi:10.3390, 8 July 2016:

Improving energy efficiency in public buildings is one of the main challenges for a sustainable requalification of energy issues and a consequent reduction of greenhouse gas (GHG) emissions. This paper aims to provide preliminary information about economic costs and energy consumption reductions (benefits) of some considered interventions in existing public buildings. Methods include an analysis of some feasible interventions in four selected public buildings. Energy efficiency improvements have been assessed for each feasible intervention. The difference of the building global energy performance index (EPgl) has been assessed before and after each intervention. Economic costs of each intervention have been estimated by averaging the amount demanded by different companies for the same intervention. Results obtained show economic costs and the EPgl percentage improvement for each intervention, highlighting and allowing for the comparison of energy consumption reduction and relative economic costs. The research results come from data gathered from four public buildings, and as such they could not be used to generically identify cost-beneficial energy efficiency interventions for every context or building type. However, the data reveals useful cost based considerations for selecting energy efficiency interventions in other public buildings.

Hannah E. Main 'Cost-Benefit Analysis Of Building Bicycle Lanes In Truro, Nova Scotia' March, 2013:

With rising gas prices, the threat of climate change, and the growing problem of obesity, bikeway networks have become increasingly popular over the past few years as an infrastructure to encourage bicycling. This thesis examines the feasibility of building bicycle lanes in the town of Truro. The costs of building a bicycle lane network in Truro are compared with the benefits. The benefits of building bicycle lanes are the benefits of switching from car travel to bicycle travel. The internal and external costs and benefits are quantified following Litman (2009). To compute these benefits, it is necessary to estimate how many people would be likely to switch from using a motor vehicle to using a bicycle if indeed a bicycle lane was in place, and how many additional kilometres would be traveled by bicycle if there was a bike lane. These estimates are found using Statistics Canada census data on number of commuters on each mode of transportation, data on average commuting distance, and previous research on the impact of bicycle infrastructure on bicycle commuting. Once these estimates have been completed, the benefits of bicycling are compared with the costs of construction of the bicycle lane network to find the estimated net benefits. Results show that when only commuters are taken into account, costs of building a bicycle lane network exceed benefits.

Rodrigo S Cassola 'Ecosystem Services and Cost-Benefit Analysis: the case of BR-319 Road in Brazilian Amazon' Version 1.1, June/2011:

Cost-benefit analysis (CBA) of infrastructure projects like road construction can be strongly influenced if the value of ecosystem services is taken into account. CBA can provide guidance for decision makers and the general public on the costs and efficiency of choices related to the implementation of such projects.

III. CONCLUSION

Suistainable building buildings are naturally different from conventional buildings. They require special materials and building practices as well as management commitment to sustainability.

In this study two case studies suistainable building building and conventional building are estimated ,energy analysis is done for an average of 10 years

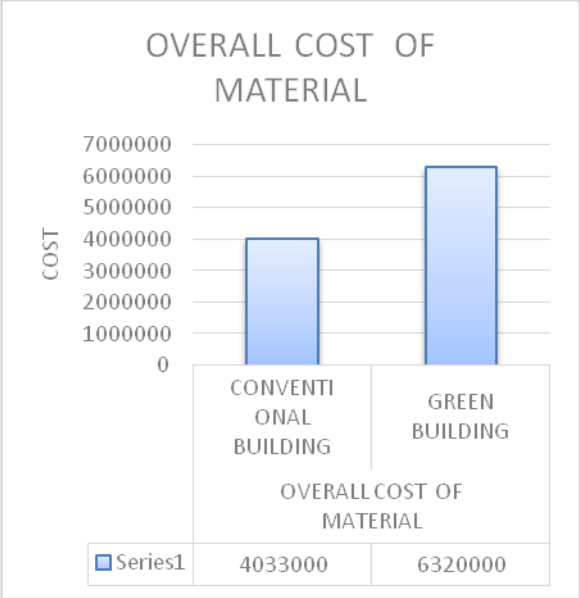
- After visiting sales department for each site it was observed that suistainable building building site is having 3 lacs profit for each unit as they are using suistainable building building component as a marketing tool which is very effective
- Suistainable building buildings have improve the chances of delivering the project within acceptable costs and schedule. Realistic financial and time constraints, superior planning, design and construction processes are needed to

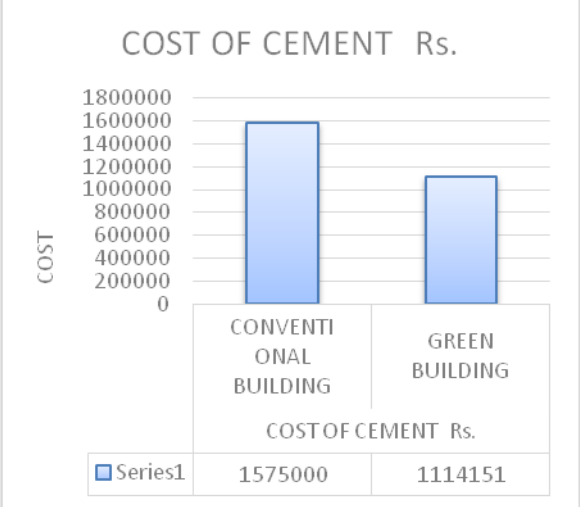
deliver a suistainable building and sustainable building project.

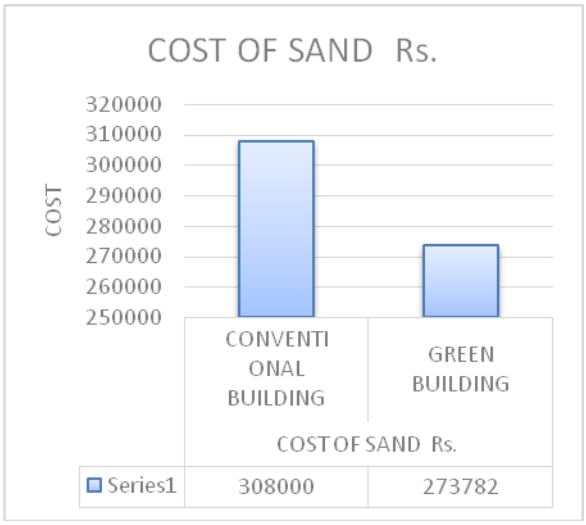
- It is important to explore the strategies for containing cost during the planning phase of a project to reduce developers first cost in delivering the suistainable building and sustainable building project Sustainable and suistainable building building requires a client who is sympathetic to this ideal, user who understands and values the concepts and designers and contractors

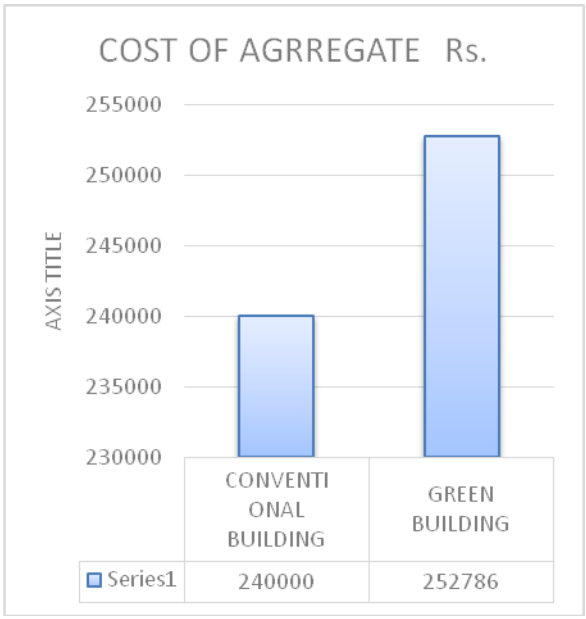
IV. RESULTS

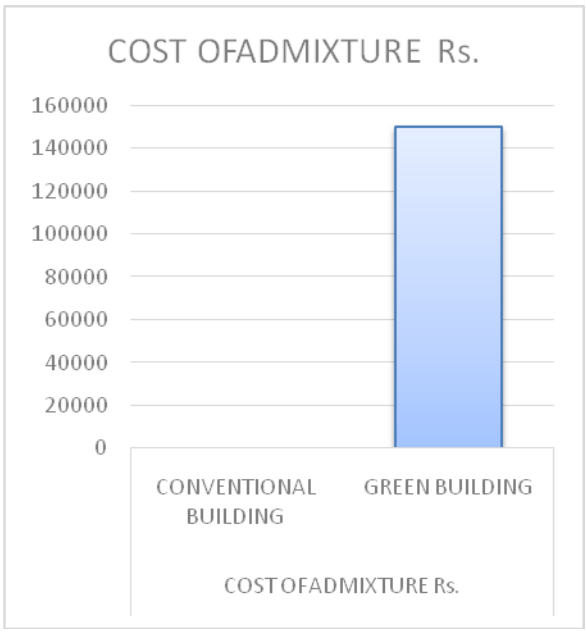
GRAPH ANALYSIS

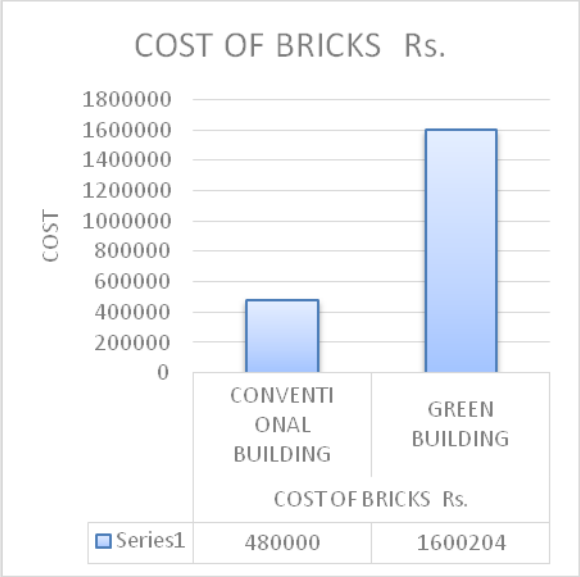


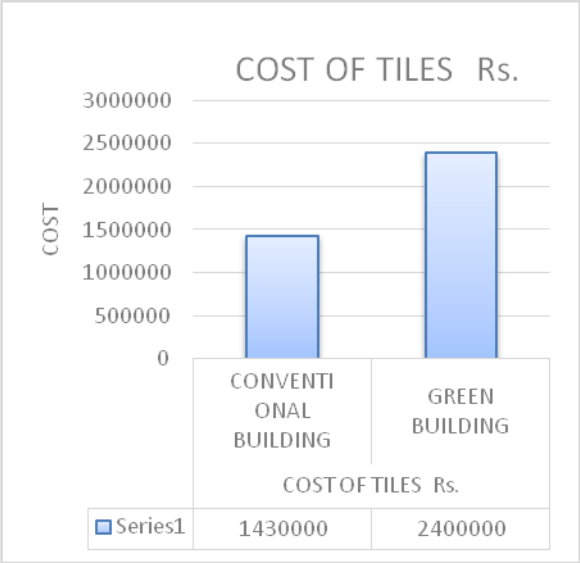


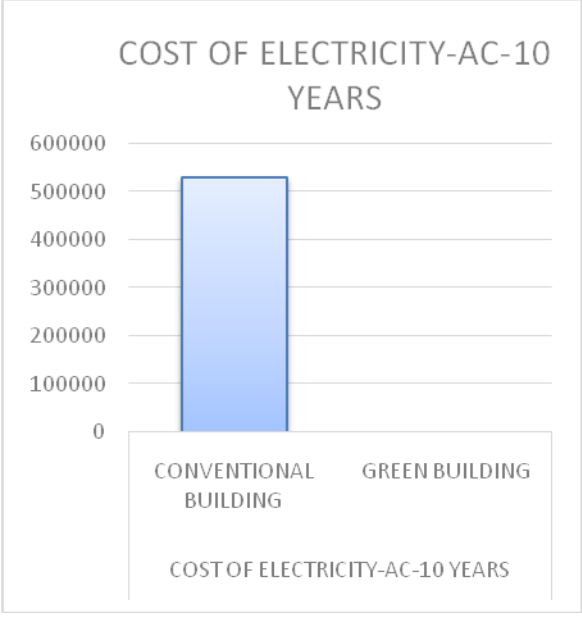


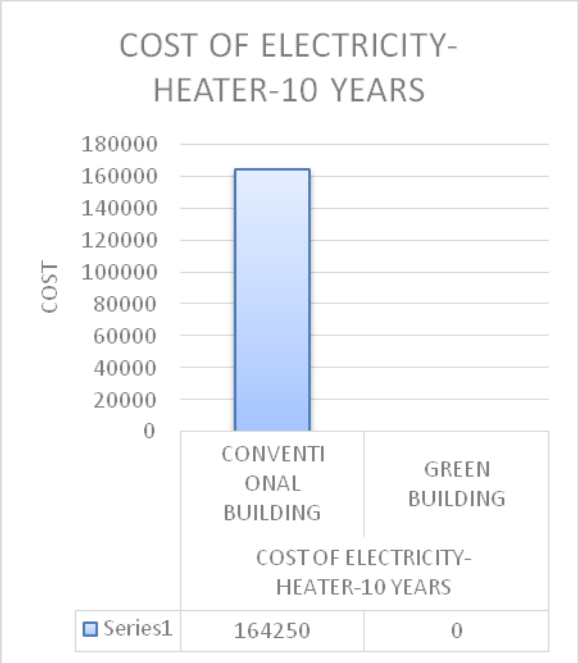












V. CONCLUSION

Green buildings are naturally different from conventional buildings. They require special materials and building practices as well as management commitment to sustainability.

In this study two case studies green building and conventional building are estimated ,energy analysis is done for an average of 10 years

- Initial cost of construction is observed 10-15% high because of additional features such as UV reflectors, solar panels,rain water harvesting.
- After analyzing the overall electricity consumption the cost benefits per flat will be 250000 over 10 years in green building per each unit so overall benefit of project will be 3600000 for entire project.
- After visiting sales department for each site it was observed that green building site is having 3 lacs profit for each unit as they are using green building component as a marketing tool which is very effective
- Green buildings have improve the chances of delivering the project within acceptable costs and schedule. Realistic financial and time constraints, superior planning, design and construction processes are needed to deliver a green and sustainable building project.
- It is important to explore the strategies for containing cost during the planning phase of a project to reduce developers first cost in delivering the green and

sustainable building project Sustainable and green building requires a client who is sympathetic to this ideal, user who understands and values the concepts and designers and contractors

REFERENCES

[1] Nushrat Shabrin, 2 Saad Bin Abul Kashem 'A Comprehensive Cost Benefit Analysis Of Green Building'volume-4, Issue-2, Aprl.-2017

[2] Executive Summary 'Cost-Benefit Analysis and the Environment' ISBN 92-64-01004-1,OECD 2006

[3] Väinö Nurmi1, Athanasios Votsis, Adriaan Perrels, Susanna Lehvävirta 'Cost-benefit analysis of green roofs in urban areas: case study in Helsinki' 2013"

[4] Anna Furberg, Sverker Molander, Holger Wallbaum 'Sustainability Assessment of Transport Infrastructures' 2014

[5] Bakhoum E. S., Garas G. L. and Allam M. E. 'Sustainability Analysis Of Conventional And Eco-Friendly Materials: A Step Towards Green Building' Vol. 10, No. 2, February 2015

[6] Greg Kats, Capital E 'The Costs and Financial Benefits of Green Buildings' October 3, 2003

[7] Davide Astiaso Garcia, Fabrizio Cumo, Mariagrazia Tiberi, Valentina Sforzini and Giuseppe Piras 'Cost-Benefit Analysis for Energy Management in Public Buildings: our Italian Case Studies' Doi:10.3390, 8 July 2016

[8] Hannah E. Main 'Cost-Benefit Analysis Of Building Bicycle Lanes In Truro, Nova Scotia' March, 2013

[9] Rodrigo S Cassola 'Ecosystem Services and Cost-Benefit Analysis: the case of BR-319 Road in Brazilian Amazon' Version 1.1, June/2011: