Cost Analysis of Green Building and Conventional RCC Building through BIM

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***Abstract*: The construction industry plays an important role in the economic growth of Country. It contributes about 2.4% to the Gross Domestic Product (GDP) of Pakistan. Due to its large size it is consuming the natural resources available in Pakistan and generates huge amount of construction waste, other problems like Emission of CO_2, time overrun, cost overrun and has adverse impact on the environment. So the Green Building Construction is most important in the construction industry of Pakistan to reduce the consumption of natural resources. Because one day these natural resources of construction materials will deplete due to the rapid growth in the construction industry of Pakistan and without using the recycled materials or finding the new alternatives. Therefore this research study is carried out to compare the cost of Green Building and Conventional RCC building to know the advantages of Green Building Construction. A ground plus one story building was taken for the case study. Autodesk Revit software was used to generate the 4D models and cost analysis. The outcome of this research study will help in adopting the Green Building Construction by knowing its advantages.**

***Keywords*: Green Building, Conventional RCC Building, Construction Industry.**

I. INTRODUCTION

Environmental changes became global issue such as climate change, disturbance in eco system, deforestation, water shortage, air pollution. To reduce such changes one of the major step is sustainable development which can be achieve by shifting construction and building industry to focus toward green and implement green methodologies. Green building is defined as the sustainable construction which reduces negative aspect and creates positive impact on our environment.
Construction industry alone participate 23% of air pollution, 50% of climatic change, 40% of water pollution and 50% of land fill waste. So to reduce such adverse effect of construction industry on environment it is necessary to promote construction of green building.

Construction of green building require special recyclable materials and system to adopt sustainability compared to conventional building, green materials are environmentally responsible materials as help in reducing environmental impact.

Conventional building is initially economical but in long run it has numerous environmental effects. Green building is taking massive uprising and in coming ages it will become conventional method of construction. In effective designing of green building new technologies are growing day by day one of latest and most efficient is BIM (Building information modeling). BIM is defined as a digital 3D representation of the project that can be used in making designing, decision making, construction schedule, planning and cost estimation and maintenance of the construction project.

A. HOW CAN WE GREEN OUR BUILDINGS?

A building can be made green in a number of ways. These include the following:

i. TAKING A SMART APPROACH TO ENERGY

- Minimize energy use at all stages of the life cycle of a building, make new and renovated buildings more comfortable and less expensive to run, and help building users to learn how to be efficient.
- Desegregation renewable and low-carbon technologies to provide buildings' energy wants, once their style has maximized built-in and natural efficiencies.

ii. WATER RESOURCE PROTECTION

- Exploring ways to improve the efficiency and management of drinking and wastewater, innovatively harvesting water for safe indoor use, and generally minimizing water use in buildings.
- Taking into account the effect of the buildings and their environment on storm water and seepage foundation, guaranteeing these are not put beneath undue push or avoided from doing their work.

iii. MINIMIZATION OF WASTE AND MAXIMIZATION OF REUSE

- Use of less, more durable materials and less waste generation, as well as accounting for the end - of - life phase of a building by designing waste recovery and reuse for demolition
- Engage users in reuse and recycling of buildings.

iv. PROMOTE HEALTH AND WELFARE

- Bring in fresh air, provide good indoor air quality through ventilation, and avoid harmful or toxic emission materials and chemicals.
- Incorporating common light and sees to guarantee building users' consolation and satisfaction of their environment, and lessening lightning vitality needs within the method.
- Design for both the ears and the eyes. In educational, health and residential buildings, acoustics and proper sound insulation play important roles in helping concentration, recovery, and peaceful enjoyment of a building.
- Make sure that people are comfortable in their everyday environments making the correct temperature inside through detached plan or development administration and observing systems.

v. MAINTAIN GREEN ENVIRONMENT

- Protecting or enhancing diverse wildlife and land quality, such as the remediation and construction of polluted land or the creation of new green spaces.
- Working to make our urban areas more efficient and bring farming to our cities.

II. MATERIALS & METHODS

A. Conventional Building Materials

The material used in this method has negative impact on the environment and uses extensive water quantity. Conventional building is initially economical but it has several impacts in the long term. Green building is undergoing massive revolt and will be conventional construction method in the coming years.
Conventional building materials such as ordinary Portland cement, tube light, VOC paints, conventional plumbing fixtures etc have adverse effect on environment.

B. Green Building Materials

Green building is defined as sustainable building, which reduces negative aspects and causes a positive environmental impact. According to U.S. GBAP "Green building is defined by using environmental responsible methodologies as a practice for the construction of structures. The structures should be resource efficient during the whole life cycle from design, operation, repair, renovation and finally deconstruction". Material is the essential part of building construction. The mechanical strength of the building depends on the chemical, physical and mechanical properties of the materials and the design of the structure. Lime, sand lime bricks, recycled plastic, bamboo, P, timber crate are some materials that are socially and economically beneficial to the construction industry and have a good impact on human health. Conventional building materials such as Ordinary Portland cement, tube lights,& VOC paint are replaced by Pozzolana Portland cement, low watt LED bulb, & Non-VOC paint in green buildings. Some of the materials used in Green Buildings are:

· Insulated Glass · PPC · Low watt LED tube and bulbs · Green plumbing Fixtures · Non plastic VOC paints · Fly ash Bricks · PVC flooring

C. AutoCAD REVIT

Revit BIM Software is a structural and MEP engineering, construction and architectural design information modeling tool. Revit is mixed with BIM, but BIM is a process that uses Revit and other modeling software and other construction features. Revit helps designers design, simulate, visualize and team up to maximize on the benefits of the interconnected data within a BIM model. In the BIM process, the word information is important. Revit creates the objects on which BIM focuses and consists of 3D models, estimates and schedules in different views. If the engineer changes data in one view, it is automatically updated in all other views because the same data are displayed in each view.
If the engineer changes data in one view, it is automatically updated in all other views because the same data are displayed in each view. If there is a change in one, any related model would reflect a change. Models can also be linked to other models such as different building design components (structure, MOU, architectural).
It also minimizes the risk of miscommunication errors because all processes are carried out via a single system.

- *3D Modeling in Revit*

Revit is for modeling of different components such as architectural, structural and MEP (mechanical, electrical, plumbing) used in 3d and in 2D as design, elevation and sections.3D modeling helps to better integrate the project team, the engineer, the project manager and the customer, because 3D view helps customers and project teams to understand more about what their customer wants and to show them what they provide.
Revit's 3D modeling can be divided into various areas, such as Revit Architecture, Revit Structure and Revit MEP. All these

models are 3D and are enhanced to 4D and 5D which is scheduling and estimation of project respectively. We are only using architectural modeling in Revit.

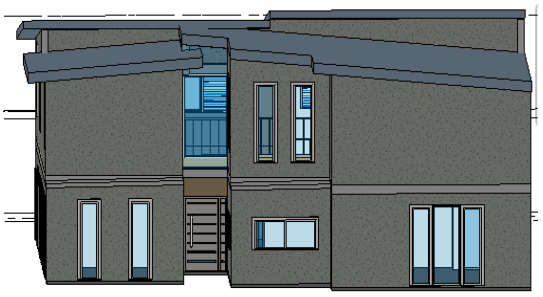

Fig. 1. model of conventional building

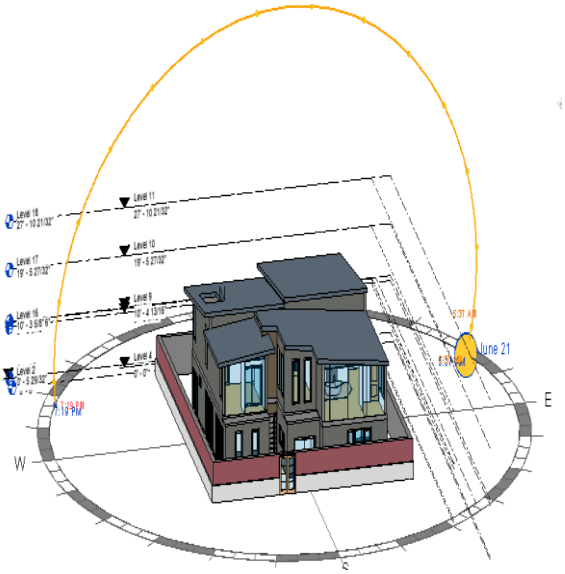

Fig. 2. 3D model of green building

III. RESULTS

Table. 1. per unit cost of different materials:

Sr. No.	Material	Conventional buildings		Green buildings	
		Material type	Cost per unit (RS)	Material type	Cost per unit (RS)
1	Cement	OPC	540 per bag	PPC	515 per bag
2	Brick	Burnt clay brick	6 per brick	Fly ash brick	5 per brick
3	Paint	Low VOC paint	900 per liter	Non-VOC paint	1200 per liter
4	Flooring	Tile flooring	2000 per meter	PVC flooring	1100 per meter
5	Doors	Solid wood	9000	Engineered wood	5000
6	Windows and openings	Aluminum paneled Plain glasses	125 psf	Double glazed / insulated glass	315 psf
7	Lighting	40 watt Tube light	180	40 watt LED Bulb	600

Table. 2. Total Cost of All Materials used in RS

Sr. No:	Materials	Green Building Materials	Conventional Building Materials	Difference

1	Lighting and Fixtures	46150	12800	33350
2	Windows and Opening	193500	130800	62700
3	Plumbing and Fixtures	108300	44885	63415
4	Flooring	264295	228540	35755
5	Doors	142510	69380	73130
6	Paints	158880	156380	2500
7	Cement	983250	966000	17250
8	Bricks	30105	50175	-25070
	Total	RS: 1921990	RS: 1658960	RS: 263030

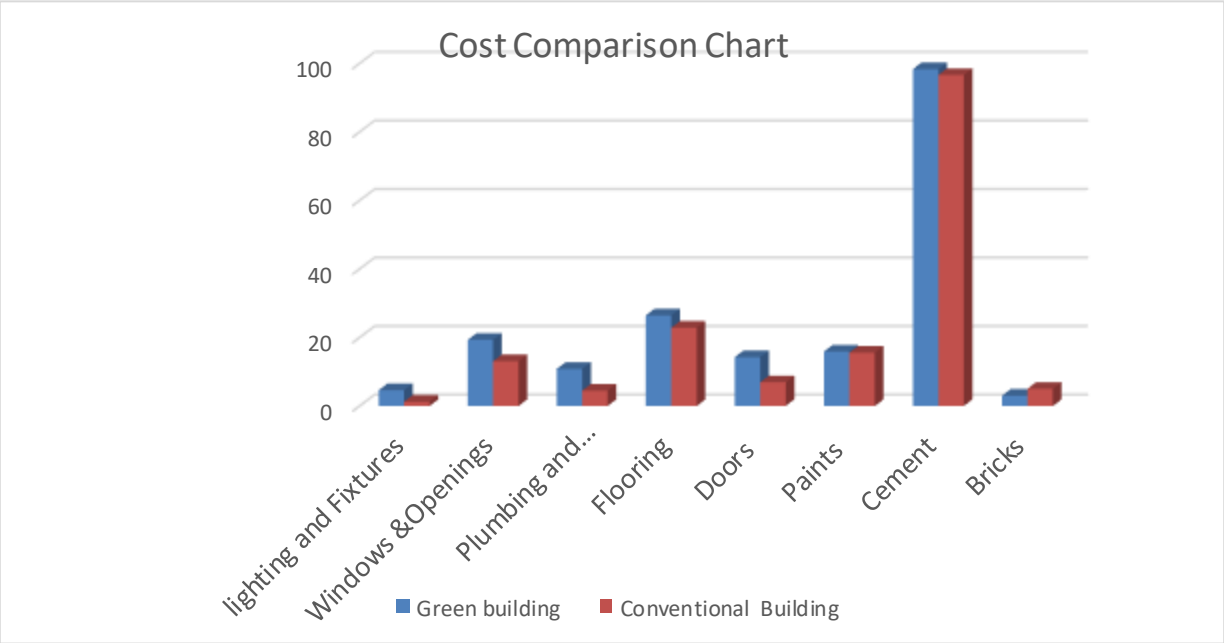

Fig. 3.

IV. CONCLUSIONS

Difference in cost of materials comes around RS 263030 which is approx. 8% (7.97%) of Total cost of Conventional RCC Building which is Rs 3295400 according to surveys conducted through Questionnaires
United States Green building council Cost of Green Building is 10 to 20 % more than Conventional RCC Building so there is minimum 2% decrease in the cost of Green Building.

V.RECOMMENDATIONS

As the total difference between the cost of construction of Green and Conventional RCC Building is not that much as compared to the damage caused to the Environment, so it will be highly recommended to use Green Construction as it is less damaging to the Environment and also becomes economical in the long run as mostly usage of Natural energy is done .

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