OPERATION AND MAINTENANCE OF GREEN BUILDINGS: A CASE STUDY

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Abstract- Conventional construction has played a massive role in contributing towards pollution and global warming which eventually leads to different diseases that have caused death but also created energy problems. To tackle this major issue, we need to convert our construction to green buildings and operate and maintain buildings according to Leed rating system. There are different systems for green buildings like Breeam, Green Globes etc. but we opted for Leed rating system as it covers more aspects of the building than any other system. A case study has been done on 3 Marla (816.752 square feet) house to show how we can operate and maintain a house according to Leed rating system. We use energy efficient sources, materials and items that can not only reduce pollution but also have a positive impact on the environment. We mainly focus on the sources, materials and items which are easily available in our country to make it more convenient and easy for the people. But the most important part of constructing or operating and maintaining a house according to LEED rating system is the return on investment (ROI) factor.

Keywords- Green buildings, Leed, rating systems, operation and maintenance

1 Introduction

The construction industry is one of the oldest industries that continues to contribute to the financial development of Malaysia [1,2]. The local construction industry needs to keep evolving by following in the footsteps of the Industrial Revolution 4.0 so that improvements can be made [3,4] Operation and maintenance of green buildings using the LEED rating system begins by exploring history of the green building movement. Many people contribute to the modern green building movement in the United States to the creation of the US Green Building Council in 1993 [5]. One of the most well-known green building rating systems in the United States is the LEED (Leadershipin Energy and Environmental Design) rating system. Created by the US Green Building Council,the LEED rating system provides a framework to create healthy, highly efficient, and cost-saving green buildings. This essay focuses on a relatively new area of sustainability as it applies to greenbuilding operation. During the past few decades, the use of green building operation has significantly increased. "Operation" refers to the decisions, systems, and methods used to ensure that a building performs and functions as intended. "Maintenance" signifies the continuous processof identifying, prioritizing, and carrying out recurring and non-recurring work [6].

2 Green Buildings

2.1 Overview of Green Buildings

As the process of urbanization more and more developed, the problems of environment and energy have further attracted people and society's concern [1]. The concept of green buildings has thus assumed the mantle of the overall theme in the contemporary construction process [9]. Green buildings' focus influences are to diminish the general impact of the

prescribed construction on inhabitants' wellbeing and the physical environment through efficient use of vitality, water and other resources, enhancing tenant health and boosting workers' productivity, reducing waste, pollution and ecological degradation.

2.2 LEED Rating System

LEED (Leadership in Energy and Environmental Design) is the world's most extensively used green structure standing system. LEED instrument provides a frame for healthy, largely effective, and cost- saving green structures, which offer environmental, social and governance benefits. To achieve LEED instrument, a design earns points by clinging to prerequisites and credits that address carbon, energy, water, waste, transportation, accoutrements, health and inner environmental quality. Green buildings are innovative structures of sustainable development in this age; since they create harmony of social, economic and environmental sustainability [7].

3 Methodology

The Figure 1 shows that a 3 Marla (816.752 square feet) house has been selected and we converted it into a green building by operating and maintaining it by using energy efficient items, sources and materials. We have replaced conventional items with energy efficient ones which obviously costed more but it will return our investment in a year or two as we don't need to pay electricity bills as we have installed a solar panel in this house. Similarly, there are other efficient items and materials also used as listed in the cost analysis Table 1. We have used items that are easily available in Pakistan. The cost that we need is around 25-26 lakhs PKR to make this house energy efficient and environment friendly which is obviously not high when we consider a return on investment (ROI) factor.

4 Result

The case study in this paper proves that green building is not only energy efficient and environment friendly but also decreases the monthly operating and maintaining cost of a house. We have operated this house for about four months and observed significant decrease in electricity bills and reduction in water consumption as low flow faucets were installed. Moreover, quality of indoor air has also improved in the house. The result shows that return on investment is 78.56% and also increase in property values ranges from 1.2% to 3.28%.

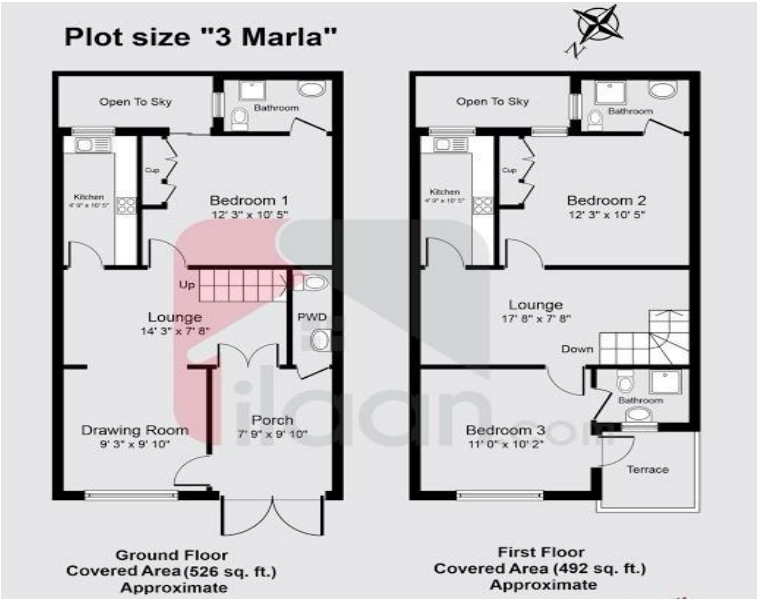

Figure 1: Drawing of 3 Marla (816.752 sq. ft.) House

All the lights are replaced with LED ones and after replacing all the electricity items such as normal refrigerators with low impact refrigerators and other items with efficient ones they are operated on solar panels which greatly reduces the electricity bills to almost nil. In this part of the world where we don't have much rain and its mostly sunny days we can't store water instead we can reduce water consumption by placing low flow faucets which makes the house water efficient. To prevent direct sun light coming into the house which eventually heat up the house double glazed windows are used instead of the conventional windows which are single glazed. Non- Toxic paints are also used which improves the indoor air quality and insulation sheets are also installed which prevents the house from heat in summers and cold in winters.

Table 1 cost Analysis

Materials	**Quantity**	**Cost (RS)**
Solar Panel(complete system)	10	(5 kw) = 750000
LED lights.	8	Rs 5675/(8 pieces) = 5675 RS
Double glazed Bedroom#3 windows 6×8(ft.)	1	Rs 1900/sq. ft. Window = 91200 RS
Non-toxic paints	40 Gallons	Rs 4000/Gallon = 160000
Insulation sheets	500 sq. m	13000 RS
Bathroom windows 2×2(ft)	3	22800 RS
Kitchen windows 3×4(ft.)	2	45600 RS
Double glazed Bedroom#1&2 windows 2.5×3(ft.)	2	28500 RS
Drawing room windows 6×8(ft.)	1	91200 RS
Low flow faucets	10	8000/faucet= 80000 RS
Automated HVAC system	1	800,000 RS
Fiber doors (Inside the house)	12	8000/door = 96000 RS
Natural Repellents	4	926/ repellent = 3704 RS
Solar shades	5	230/sq. ft. = 16445 RS
Tank less water heaters	3	14000/tank = 42000 RS
Air purifiers	3	15,499/purifier = 46497 RS
Low Impact Refrigerators	2	112024/refrigerator = 224048 RS
Locally source building materials	Steel, fly ash bricks,	According to requirements -
Green Roof Materials	-	-
VOC-Free adhesives	-	1300-1500 RS/ bag
Green concrete	-	According to requirements
Sensor lights	8	4000/light = 32000

6 Practical Implementation

This experimentation helps in selecting the most effective materials and items to enhance the building's efficiency and make it environmental friendly.

7 Conclusion

In conclusion, the paper has articulated a set of comprehensive strategies for maintain and operate a home based on the LEED principles. As it is clearly mentioned above that by replacing the conventional items with energy efficient ones as they are mentioned in the Cost Analysis Table 1 the efficiency of the house improves. The objectives of the strategies have been energy and water efficiency as low flow faucets are installed, using of sustainable materials and incorporation of smart technology in operation. Home owners that can afford the investment stand a chance to reap long-term benefits as the utility costs will reduce. More so, the environmental footprint will be minimal compared to the beginning. This is even though will be costly at the start. Additionally, the paper has shown some of the financial reports and the environmental benefits of the adoptions and practices of the assessed strategies, and they are a wise and responsible decision of homeowners who want to have greener more comfortable home. More so, the LEED rating system is vital in operating and maintaining green buildings.

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