

# Upgradation of a Building to Higher Certification Levels as per LEEDv4 - Case Study

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**Abstract:** There is a general perception among the developers and clients that green buildings shall incur additional costs. For the same reason, they always prefer conventional buildings over green buildings. If at all they are going for green buildings, they always tend to go for lower rating levels. Most of the clients and contractors are either ignorant or unaware of the possibilities of a higher certification level without much increase in the total cost. Suppose they are educated about the possibilities of going for a higher certification level, cost of doing so and also a budgeting methodology for controlling the cost, it will definitely be an incentive for clients, owners, designers, and users to develop and promote highly sustainable construction practices. In this paper, a building that has attained a particular certification level in LEED India v1 is evaluated using LEED v4 to estimate the rating that it could achieve under LEED v4 and to determine the possibilities of upgrading the building to higher certification levels within v4. Credit wise evaluation has been done to determine the elements required for up gradation and also the cost of up gradation (in the Indian context) and on the basis of this evaluation as well as some literature review, a budgeting methodology is developed.

**Keywords:** Green Buildings, LEED India v1, LEED v4, Preliminary Analysis, Budgeting Methodology.

## Introduction

The idea of green building can be considered a major reform in the construction industry. The attitude of the public as well as their views towards green buildings may affect its application. An important reason why people tend to go for the conventional buildings or green buildings of lower ratings is that they perceive a huge percentage increase in the total construction cost. Hence in this paper, all the prerequisites and credits of LEED v4 are evaluated in the context of a selected building in India to determine the possibilities of a higher certification level. The building has achieved silver rating under LEED India v1. Therefore this evaluation also helps in understanding the difference in credit requirements that have occurred in LEED over the years. Benefits of certification through the latest version (v4) is that it can be a valuable educational and marketing tool for owners and design and construction teams, through the process of creating a more sustainable building. We are not just focusing on “What extra is it going to cost?” but on “How can we do it?” as well. I.e. in addition to the cost, we are also considering the factors for upgradation of a building. After the evaluation, a general budgeting methodology is developed for cost control.

## Literature Review

Social acceptance of green buildings definitely affects the clients or owners willingness to build environmentally responsible structures. Ref. [1] has demonstrated the level of acceptance of green buildings and social problems related to green buildings. From their survey, they have concluded that, when educated about green buildings, 90% of the sample would pay more for a green building over the standard building. Hence analysing the cost of green features is an important research theme.

Cost of green features varies depending on the rating system chosen. Ref. [2] did a comparative review of the five rating systems namely BREEAM, LEED, CASBEE, GREEN STAR and HK-BEAM. Categories considered for review were popularity and influence, availability, methodology, applicability, data collecting process, accuracy and verification, user friendliness, development, results presentation. As per the study, LEED and BREAM achieved the highest scores. Ref. [3] analysed BOMA Go Green, BREEAM (UK), Green Star, Passive House, The Living Building Challenge and LEED. This study also shows that LEED has a dominance above its counter parts. Ref [5] has evaluated the operational expenditures of certified buildings. The installation and disposal costs have not been considered. The results of the comparison of the selected certified buildings also shows that LEED certified buildings achieve energy and water savings because of the LEED mandatory requirements. Hence LEED may be considered as one of the best choices for pursuing green building certification.

Many developers have a common perception that green buildings have high development costs. I.e. they perceive that the construction would incur additional costs. Ref. [5] divides the cost of construction into land, hard and soft costs and has analysed the soft costs associated with development of a green building. Though only soft costs were studied, it was identified that the experts had a unanimous opinion that international green rating tools such as LEED are easier to achieve at less capital cost compared to the Malaysian GBI rating tool. This is an incentive to determine the cost of green features in green buildings.

Ref. [6] in a report submitted to California's Sustainable Building Task Force, The cost and financial benefits of green buildings, demonstrates conclusively that sustainable building is a cost-effective investment, and its findings should encourage communities across the country to "build green." This report represents one of the most definitive cost benefit analysis of green building ever conducted. The report also evaluates the various problems in determining cost.

Ref. [7] recognizes the need for building an appropriate cost model for the buildings. The report also says that as a part of staying on track, it is necessary to update and monitoring of the LEED check list.

Even though several studies have been conducted in determining the soft costs and hard costs associated with green buildings, the cost of upgradation of a building to higher certification levels by incorporating additional green or sustainable features at the beginning of the project itself is a less researched topic.

### **What is a green building?**

Green building is a concept that agrees upon the fact that buildings have profound effects on the surrounding environment as well the occupants. Green buildings plays a major role in intensifying the positive effects and eliminating the negative effects.

### **LEED**

Leadership in Energy and Environmental Design (LEED) developed by the U.S. Green Building Council (USGBC), is a set of rating systems for the design, construction, operation, and maintenance of green homes, buildings and neighbourhoods. LEED is organized into a set of environmental categories and these categories are subdivided into prerequisites and credits. Prerequisites are mandatory and must be achieved and therefore should be immediately addressed by the team. Credits are based on desired performance goals within each category.

### **LEED India v1**

In LEED India v1, six major environmental categories are considered for sustainable development. Namely sustainable sites, water efficiency, Energy and atmosphere, Materials and resources, Indoor environmental quality & innovation. The environmental categories are subdivided into the established LEED - INDIA credits, which are based on desired performance goals within each category. The scores are certified: 26-32, silver rating: 33-38, gold rating: 39-51, platinum rating: 52+.

### **LEED v4**

LEED v4 is the most recent version of the world's premier benchmark for high-performance green buildings. USGBC claims this version to be more specialized, bolder and designed for an improved user experience. Unlike LEED India v1, eight major categories are considered for sustainable development, namely Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality & Innovation. A comparison of LEED India v1 and v4 shows that the points are more difficult to achieve in the case of LEED v4 and also LEED v4 gives more importance to high performance cost effective outcomes, reducing environmental impacts and improving liveability and human health. The scores in LEED v4 are certified: 40-49, silver rating: 50-59, gold rating: 60-79, platinum: 80-110. It can be seen that the scores have been raised for each rating level, making it even more difficult to achieve.

### **Preliminary Analysis and Cost Based Assessment**

An office building having 3B+G+8 floors with two towers, location: Chennai, total project value of 225Cr and having a silver rating under LEED India v1 was chosen for the case study. A feasibility checklist was prepared as per LEED v4 and the building was evaluated on the basis of this checklist. The preliminary analysis showed that, the building which achieved a silver rating under LEED India v1, is eligible for basic certification level only (47 points) when evaluated under v4. The summary of the preliminary analysis is shown in table 1.

From the table, it can be seen that the project is readily eligible for certification level only as per LEED v4. Also it can be seen that, with some additional effort, a maximum of 33 points can be earned extra. Thus with some minor/major additions to the project, it could have aimed for platinum rating.

The cost based assessment of the credits that are readily achievable as per preliminary analysis, is given below.

## Location and Transportation

*Sensitive Land Protection:* There are typically no construction or soft costs associated with this credit. It is an outcome of site selection. However to get the CDMA permit (construction permit), which approves that the development footprint is not on a land that meets the criteria for sensitive land, CDMA scrutiny charge of INR 1.5 per square meter of the land area need to be considered.

*Surrounding Density and Diverse Uses:* This credit is usually a result of site selection rather than a driver. The building being in an urban area with high surrounding density, no construction or soft costs incurred.

Table 1. Summary of the points earned, pending and not eligible for

| Major Credit Category                                                           | Points achieved under preliminary analysis | Points that could be achieved by minor or major additions to the project | Points that the project is not eligible for |
|---------------------------------------------------------------------------------|--------------------------------------------|--------------------------------------------------------------------------|---------------------------------------------|
| Integrative process (This credit doesn't fall under any major credit category). | 0                                          | 1                                                                        | 0                                           |
| Location and Transportation                                                     | 12                                         | 1                                                                        | 3                                           |
| Sustainable Sites                                                               | 8                                          | 2                                                                        | 0                                           |
| Water Efficiency                                                                | 8                                          | 1                                                                        | 2                                           |
| Energy and Atmosphere                                                           | 6                                          | 11                                                                       | 16                                          |
| Materials and Resources                                                         | 2                                          | 6                                                                        | 5                                           |
| Indoor Environmental Quality                                                    | 5                                          | 7                                                                        | 4                                           |
| Innovation                                                                      | 3                                          | 3                                                                        | 0                                           |
| Regional Priority                                                               | 3                                          | 1                                                                        | 0                                           |
| Total                                                                           | 47                                         | 33                                                                       | 30                                          |

*Access to Quality Transit:* This credit is also usually a result, rather than a driver, of site selection. Project is located on a site where public transportation is already available nearby. Hence no extra costs involved.

*Green Vehicles:* In order to achieve this credit, 5% of the parking space is designated as preferred parking space for green vehicles. Also electric vehicle supply equipment are installed to meet the requirement (26000 INR per piece).

## Sustainable Sites

*Preq: Construction activity pollution prevention:* As a part of construction activity pollution prevention, an erosion and sedimentation control plan was formulated and implemented. Top 20 cm thick soil was stripped and stacked at site (120 INR per cum for excavation and stacking). Also while construction, temporary seeding was done to prevent erosion or sliding.

*Site Assessment:* As a typical approach to this credit, a site survey was performed. The soft costs associated with this credit are not very high.

*Site Development - Protect or Restore Habitat:* The site is on previously developed area and not on a green field area. Hence 30% of all portions of site identified as previously disturbed were restored using native vegetation costing Rs 600 per sqft.

*Rainwater Management:* There are a number of options for reducing the runoff at site and cost depends upon your choice. Here in this case, a rainwater storage sump of 100 cum capacity (18 lakh INR) has been provided. Additionally, concrete interlock pavement with permeable joints (have an underlying of open graded bedding course, open graded base course and open graded subbase on compacted soil subgrade, 80 INR per sqft) is provided Then we have vegetated open space and the cost for the same has already been considered. We also have roof garden (950 INR per sqft). Also pervious pavers have been provided for roof garden.

**Heat Island Reduction:** Both the options (non-roof and roof, parking under cover) have been satisfied. First option is roof and non-roof measures and on achieving this credit you get 2 points

Area of non-roof measures = Area of pervious pavers or open grid pavement system + Area of trees providing shade  
= 43211.03 sqft+ 2081.55 sqft.

Cost of both have already been considered for achieving other credits like rain water management, protection and restoration of habitat etc.

Area of high reflectance roof = 23583 (tower A) + 23736 (tower B)  
= 47319 sqft.

Cost of providing albedo coating is 45 per sqft. Area of vegetated roof = 20696.59 sqft and the cost has already been considered under the credit rain water management. Hence the total cost coming is only 21, 29, 350 INR.

Second option is parking under cover. If you are going for this option, you get only 1 point. Due to lack of space, instead of providing it at ground level and providing cover for the same, basement parking has been provided. This actually satisfies the credit and provides 100% shade compared to the ground level parking system. This would cost around 2500 INR per sqft. If

we go for the normal ground level parking system, it would cost around 1500 INR per sqft. Therefore the difference per sqft for greening comes to be Rs 1000 per sqft. Total parking area = 322099.26 sqft. Therefore additional cost =  $322099.26 \times 1000 = \text{Rs } 32,20,99,260$ . Considering the huge cost difference and also the points achieved, first option has been attempted.

### **Water Efficiency**

*Prereq: Outdoor Water Use Reduction:* With the intention of reducing the water usage, STP 400 cum per day capacity was constructed. This onsite treatment of water would add considerably to the total cost (1.2 Cr INR). Also for reducing the outdoor water usage, native species have been used in outdoor vegetation. The cost of the same has already been considered.

*Prereq: Indoor Water Use Reduction:* Typical approach to go for this credit is to go for low flow plumbing fixtures having water consumption less than 20% from the baseline. Through careful choice of low flow plumbing fixtures and elimination of cooling towers the project has achieved 100% indoor water use reduction.

*Prereq: Building-Level Water Metering:* As a typical approach to achieve this prerequisite, permanent water meters (1.2 lakh INR per meter inclusive of installation charge) have been installed for measuring input water to the STP, output from STP to HVAC system, flushing system and irrigation.

*Outdoor Water Use Reduction:* In the process of satisfying the prerequisite, 50% reduction was already achieved. Hence we needn't consider an extra premium for this credit.

*Indoor Water Use Reduction:* In the process of satisfying the prerequisite, 100% reduction was achieved. Therefore here also we needn't consider an extra premium.

### **Energy and Atmosphere**

*Prereq: Fundamental Commissioning and Verification:* Third party commissioning agent has been assigned to carry out the commissioning process.

*Prereq: Minimum Energy Performance:* Since energy efficient design, right sizing of the equipment and improvements in basic building systems etc. are an integral part of this project, similar to majority of the multi crore projects, this credit requirement of 5% improvement in energy efficiency, is easily achieved within the base cost. Hence there is no added cost. However we need to consider the soft costs for demonstrating this improvement in energy performance using whole building energy simulation system.

*Prereq: Building-Level Energy Metering:* As a typical approach to achieve this prerequisite building level energy meters and sub meters have been installed. Individual meters are quite inexpensive. As per the prerequisite, we require 1 HT energy meter, then we require sub meters for measuring the supply to the plug points, lighting & HVAC systems. Each tower requires these separately. Therefore we need a total of 6 sub meters

*Prereq: Fundamental Refrigerant Management:* The cooling load works out to be around 2216 TR in total. Therefore a system consisting of 6 numbers of 370 TR (working) and 1 number of 370TR (stand by) capacity air cooled screw chillers have been provided. Refrigerant used is R134A which is free of CFC, HCFC and halogens. A chiller with refrigerant such as R134A would cost almost Rs 20 lakh more than the less environmentally responsible ones.

*Enhanced Commissioning:* Cost already considered for meeting the prerequisite.

*Enhanced Refrigerant Management:* Cost already considered for meeting the prerequisite.

### **Materials and Resources**

*Prereq: Storage and Collection of Recyclables:* The credit has no soft cost impact. For the purpose of collection of recyclables, a bin center 150sqm was constructed (Rs 750 per sqft). In addition to this, individual collection bins are provided to all occupants

*Prereq: Construction and Demolition Waste Management Planning:* As a part of construction and demolition waste management planning, some of the materials have been reused within the site. For e.g., concrete debris and concrete masonry blocks are reused within the site for making temporary roads, infrastructure fill etc. Steel scrap is reused within the site for precast item, grade slab, drain, lintels etc. Whereas materials such as card board, wood etc. are sold to the external agencies for recycling. Hence no additional cost is incurred.

*Construction and Demolition Waste Management:* As explained in the prerequisite, no added cost.

### **Indoor Environmental Quality**

*Prereq: Minimum Indoor Air Quality Performance:* The technologies and standards required for this prerequisite are standard to this project also like most projects and in majority of the cases, this prerequisite has low cost impact. The prescribed standards for ventilation are usually met without any added cost. However in order to satisfy the prerequisite, for the purpose of monitoring, outdoor airflow measurement device for mechanically ventilated spaces and also CO2 sensors (15000 INR) are provided. For direct outdoor airflow measurement, we can use airflow measuring stations (50000 INR per piece) are used.

*Prereq: Environmental Tobacco Smoke Control:* Since the company has opted for a no smoking policy, the costs associated with providing designated areas, with adequate ventilation, for smoking are eliminated. However while adopting the non-smoking policy, the prerequisite requires that signage be posted within 3 meters of building entrances.

*Enhanced Indoor Air Quality Strategies:* As per the credit requirement, entryway systems have been provided at all regularly used exterior entrances. As entry way system, we are using air curtains, 3 m long and 2.5 meters high (25000 INR).

*Construction Indoor Air Quality Management Plan:* Air handling equipments used already meets the standards, hence no added cost. Also tobacco products are banned at site and hence no expense in this regard also. However some amount has been set aside for protecting the absorptive materials stored on site, Miscellaneous works (like covering up of ducts, harmful materials etc.), housekeeping works etc.

*Indoor Air Quality Assessment:* As building flush out was done, the credit requirement is satisfied. It costs in the range of Rs 15 to Rs 25 per sqft

*Thermal Comfort:* This project also like most of the projects are already designed to comply with the ASHRAE standards. Hence no added cost.

*Acoustic performance:* The maximum background levels from HVAC systems are as per 2011 ASHRAE Handbook, HVAC Applications. Hence this credit is achieved with no cost impact.

**Innovation**

*Innovation:* Since we have achieved exemplary performance in other credit categories like indoor water use reduction of 100%, heat island reduction, there is no added cost and we are getting two points also

*LEED Accredited Professional:* The cost component coming under this credit is the professional fee.

**Regional Priority**

*Regional Priority:* The three points achieved in this category are for the achievement of credits that address geographically specific environmental, social equity and public health priorities. There is no cost implication for this credit as such as you would have already considered it for those specific credits.

**Summary of the additional cost incurred (green cost) per major environmental credit category**

Based on the preliminary analysis, the cost increment (green cost) per satisfied prerequisite and earned credit was calculated and the average cost increment (from the conventional practice/ process/ construction) per major credit category is tabulated in table 2

It can be seen from the table that the green cost for achieving certification in LEED v4 for this particular building is 9.5 Cr, corresponding to just 4.22% of the total cost of the project.

**Assessment of the pending credits to determine the opportunities and cost of upgradation to higher certification levels**

*Integrative Process:* This credit is basically for the identification and use of opportunities to achieve synergies across disciplines and building systems. It doesn't involve any construction cost. However soft costs associated with modelling are to be met. The credit requires that a preliminary simple box energy modelling be performed before the completion of schematic design. This credit also requires that a preliminary water budget analysis be performed and documented. Therefore by spending on simple box energy modelling and water budget analysis it is possible to achieve this credit.

Table 2. Green cost per major credit category

| Major Credit Category        | Cost of green in lakhs |
|------------------------------|------------------------|
| Location and Transportation  | 2.65                   |
| Sustainable Sites            | 432.5                  |
| Water Efficiency             | 202.1                  |
| Energy and Atmosphere        | 148.3                  |
| Materials and Resources      | 158.9                  |
| Indoor Environmental Quality | 15                     |
| Innovation                   | 6                      |
| Regional Priority            | 0                      |
| Total                        | 950                    |

**Location and Transportation**

*LEED for Neighbourhood Development Location:* Projects attempting this credit are not eligible to earn points under other location and transportation credits. Since the project has already attempted other credits under this major credit category, we are not eligible to this.

*High Priority Site:* The project is not in a historic district or priority designation and it is not a brown field remediation also. Hence not eligible for this credit.

*Bicycle Facilities:* The credit has a very low price impact and hence we can readily go for this credit. This credit requires that bicycle storage is within 200 yard (180 m) from a bicycle network. Retrofitting a common area for bike storage can be pricey, costing anywhere from Rs 10000 to Rs 15000 per bike. Common areas with underused space, such as under stairwells or in parking garages, are good options for allocating two-wheeler parking. We can provide floor to ceiling bike rack which is less space consuming. Also shower rooms need to be provided. Providing so in the required numbers, this credit is easily achievable.

*Reduced parking footprint:* As per local zoning requirement, 1 car parking space must be provided per 100 sqm. FSI Area = 42263.76 sqm. Therefore 423 parking spaces have been provided. The credit requires that 40% reduction below this baseline be achieved. That parking spaces must be limited to 254 nos. In two towered office with a total occupancy at around 5115, this is quite impossible to achieve.

### **Sustainable Sites**

*Open space:* The credit requires that outdoor space greater than or equal to 30% of the total site area including the building footprint be provided. Also 25% of this outdoor space need to be vegetated.

Open space = 65821.42 sqft = 38% of the total site area.

Vegetated space = 22788.6 sqft = 34.6 % of the total open space.

Hence the above two conditions are already satisfied, Now we just need to incorporate some physical site elements that accommodate social activity as specified in the credit. Therefore this credit is achievable with less cost implications.

*Light Pollution Reduction:* This credit is basically to improve the night time visibility and reduce the consequences of development for wild life and people. The credit requires that the up light and trespass requirements be met as per the BUG rating method or the calculation method. Proper designing of the exterior lighting fixtures by taking into account the site security factor as well can help achieve this credit without much cost increment. Before lighting design, initially we must classify the project under one lighting zone. Based on the definition provided in MLO User guide, the project falls under the zone LZ3. Accordingly a set of fixtures may be chosen to meet the credit.

### **Water Efficiency**

*Outdoor Water Use Reduction:* Additional reduction in outdoor water use, 100% reduction, is possible by an irrigation audit and irrigation scheduling on the basis of the findings from audit. Soil, plant or atmosphere based measurements are used by agencies in preparing irrigation schedule. Then for large lawn areas, we can opt for sprinkler irrigation system. The sprinkler output may be tested to adjust the time. Rain or soil moisture sensors may be used. Once it detects a designated amount of water, it shuts down the supply. Then some inexpensive methods may be used like locating sprinklers so that they are between 4 and 6 inches (10-15cm) from the edge of sidewalks, curbs, patios, etc. in lawn areas. In shrub areas they can often be 12 inches (30cm) from the edge, especially with a mature landscape. This will reduce the amount of spray onto the paved surface and will not create a dry area along the edge of the lawn. It will also reduce the amount of damage that trimmers cause to the sprinkler heads. Sprinkler system should not be installed on a sloping area as this reduces the efficiency and they spit and spew when the valve is turned on. Then for the shrub area, drip irrigation may be used as its 20% more efficient than sprinkler irrigation system and very little water is lost from evaporation or runoff. The total cost of achieving this credit is calculated by considering that all the above mentioned methods shall be adopted.

*Cooling Tower Water Use:* Air coolers are used in the campus for achieving exemplary performance in indoor water use reduction (100% reduction). Hence this credit cannot be attempted.

### **Energy and Atmosphere**

*Optimize Energy Performance:* This credit involves substantial construction costs. There are two options in achieving points under this credit. Under the first option, you can demonstrate a percentage improvement in the energy performance or you can take the data from analysis of similar buildings in published data such as Advanced Energy Design guides. Another option is to go for prescriptive compliance for building envelope, interior lighting, exterior lighting, plug loads, it is possible to achieve a maximum of 5 points in this method. The total points that can be achieved in the event of compliance with the first option (i.e. based on published data) is less than that from prescriptive compliance. Hence the second option has been considered in the cost calculations.

*Advanced Energy Metering:* The cost of providing individual meters is not very significant, however, the cost of providing a good reporting system could be substantial. Still, the credit is feasible.

*Demand response:* The typical approach to achieve this credit is to enter into a contract with a demand response provider. There are no cost implications, instead the building owner gets paid for the energy curtailment he makes. There is compensation even for participation in demand response program. You are also eligible for a substantial one time incentive to

pay for control system upgrades. Hence this credit considered as achievable under the assumption that a demand response provider is available.

*Renewable Energy Production:* The project can achieve a maximum of 3 points under this credit by using renewable energy systems to offset building energy costs. Since we are attempting the credit Green Power and Carbon offsets, showing 50% of the buildings energy as from renewable source, we are eligible for all the 3 points.

*Green Power and Carbon Offsets:* The credit could be achieved by entering into a green power contract is usually in the range of \$.02 or Rs 2 per kWh.

### **Materials and Resources**

*Building Life-Cycle Impact Reduction:* This credit is difficult to achieve in this project as it does not come under historic building reuse or renovation of abandoned or blighted building, building. Also there is very less opportunity for reuse of reused, refurbished or salvaged materials in the project.

*Building Product Disclosure and Optimization – Environmental Product Declarations, Sourcing of Raw Materials, Material ingredients*

With more and more manufacturers supplying materials complying with this credit, experts in procurement say these credits could be achieved with an average cost increment of .1% over the total cost of materials.

### **Indoor Environmental Quality**

*Enhanced Indoor Air Quality Strategies:* One extra point could be achieved for additional IAQ strategy such as sensors for additional source control and monitoring (for specific pollutants).

*Low-Emitting Materials:* If proper planning and study are done before finalizing the materials to be procured, low emitting materials could be bought with an average additional cost of 15% over the cost of conventional materials. However this credit becomes hard to achieve for some projects when suitable materials or products are less readily available.

*Thermal Comfort:* Since the project complies with the ASHRAE standards, there is no added construction cost. However we need to properly design the HVAC systems and the soft costs for the same may be considered.

*Interior lighting:* There are two options to satisfy this credit, lighting control and lighting quality. Lighting control requires that for 90% of individual occupant spaces, individual lighting controls be provided and for multi occupant spaces, multi zone control systems be provided. The cost can be moderate to substantial for this option. This option is difficult to pursue in this case as the occupancy number is very high, 5115 persons. Option 2, lighting quality requires that the lighting fixtures be as per the specifications in LEED. To satisfy this, you can expect an overall increase of 30 to 40% in cost over the total cost of lighting fixtures.

*Daylight:* As the annual sunlight exposure 1000, 250 ASE1000, 250 exceeds 10% threshold mentioned in LEED, this credit cannot be attempted. Otherwise we should consider the soft costs for performing spatial daylight autonomy simulations.

*Quality Views:* We already have high performance vision glazing and in order to achieve this credit, we just have to go for thoughtful arrangement of the interior space.

### **Innovation**

*Innovation:* Through easy methods like green education, green cleaning etc., this credit could be achieved with low or moderate cost impact.

### **Regional Priority**

*Regional Priority:* By crossing the threshold for renewable energy production, this credit could be achieved.

### **Summary of the additional cost incurred (green cost) per major environmental credit category**

Based on the above evaluation, the green cost required per pending credit to achieve a maximum possible score of 80 (corresponding to Platinum rating), for this project, was calculated and the cost per major environmental credit category is summarized in table 3.

It can be seen that by spending an extra premium of just Rs 8.7 Cr corresponding to 3.9% of the total cost of the project (225 Cr), in the initial stages of the project itself, it is possible to achieve platinum rating for this project.

### **Guidelines for cost control**

A number of studies have proved beyond doubt that the green buildings shall payback during its lifetime itself. There are a number of factors that influence the total cost of green features. If left unchecked, the total cost could shoot up affecting the project completion or project delivery or could even result in huge losses. The following standard set of procedures could help us go for higher certification levels without much increase in the total cost.

Table 3. Green cost per major credit category for the pending credits

| Major Credit Category                                              | Cost of green in lakhs |
|--------------------------------------------------------------------|------------------------|
| Integrative process (Doesn't fall under any major credit category) | 8.75                   |
| Location and Transportation                                        | 30.2                   |
| Sustainable Sites                                                  | 7.92                   |
| Water Efficiency                                                   | 31.59                  |
| Energy and Atmosphere                                              | 577.1                  |
| Materials and Resources                                            | 47.78                  |
| Indoor Environmental Quality                                       | 17.4                   |
| Innovation                                                         | 0                      |
| Regional Priority                                                  | 0                      |
| Total                                                              | 877.65                 |

### Defining the scope and requirements

From the very beginning, the project requirements must be well conveyed and the scope made clear to all the members of your team.

#### Team work

The ease with which you can blend in the green features, satisfy the prerequisites which are mandatory and earn credits, depends to a great extent on the expertise of your team in the corresponding certification program. Whether or not the members of the team, both the design and construction team, are acquainted with the certification system, sustainable practices defined in the system, certification process etc. can have profound effects on the project value. Good team work is a secret key to effective cost control

### Feasibility and cost based analysis – Finalize the rating to be targeted.

A feasibility checklist should be prepared at the project start itself and this must be updated regularly. Feasibility checklist provides a platform for credit wise cost and feasibility analysis. It helps to identify the possibilities of a higher rating. Accordingly the design and the construction teams may be informed to make cost effective changes to the project.

### Budget allocation

Now you have in hand, a target rating level and also total available budget. Check if the funds are sufficient to meet the target. This is where the cost based analysis of credits gain importance. If an insufficiency is recognized, the goals must be either reduced or the funds increased. The project teams must not proceed forward with the same set of goals without finding a solution to insufficiency of fund as this could even affect the project completion to a large extent. Also going forward with insufficient funds will lead to more drastic scope cuttings in future than you would expect.

To align the budget with the program, a cost model should be prepared. Majority of the cost elements, in quantity as well as quality, will be available from the program and from that it is possible to build a cost model. This shall serve as a communication tool for the project team, letting a clear understanding of any limitations in budget.

Another important finding from the analysis is that costs are not necessarily cumulative. In many cases, a design/ green feature that allows a project to meet one sustainable design criteria will also allow that project some other criteria also without any additional cost impact or with minimal cost impact. This understanding also helps in budgeting to a great extent.

### Being up to date

It is very important to be up to date to have a firm grip on the project. The steps for being on track are:

*Paper works:* Start any documentation work as early as possible, and stick on to it as you proceed with the project work.

*Energy models:* Prepare energy models to inform the design team about changes to be made to cross the thresholds mentioned in the certification systems.

*Monitoring and updating of checklist:* Monitor and update the checklist regularly to see if the sustainability goals are being met.

*Cost models:* Prepare cost models, validate the same and use them to predict the green costs.

### Conclusion

The best possible way to budget for green features in order to achieve the highest rating possible for the building is to identify the goals, perform energy modelling, prepare a feasibility checklist and to build an a cost model for them in the initial stage of the project itself.

The project chosen for case study could have achieved the highest possible platinum with just 3.9% cost increment over the total cost, had it done a feasibility and cost based analysis in the predesign phase itself.



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