LEED Breadth

Introduction

As of January 2007, the project team has attempted to achieve a total of 50 points under the "Leadership in Energy and Environmental Design for New Construction" (LEED-NC) rating system. Assuming that all these points are awarded, the Student Resource Building is expected to achieve a Gold certification status. Currently, points are being attempted in the following areas:

LEED-NC Category	**Points Attempted**
Sustainable Sites	14
Water Efficiency	5
Energy and Atmosphere	17
Material and Resources	13
Indoor Environmental Quality	15
Innovation in Design	5

Of the 50 total points, 35 are related to the design and 15 to construction. Based on the "LEED-NC 2.2 Reference Guide", LEED-NC ratings are awarded according to the following scale:

LEED-NC Rating	**Scale**
Certified	26-32 points
Silver	33-38 points
Gold	**39-51 points**
Platinum	52-69 points

The aim of this study will be to see if additional points can be achieved to push this project to Platinum status. In particular, the feasibility of achieving the following points will be investigated:

Credit Attempted	**Credit Description**
EA Credit 2	"On-Site Renewable Energy"
MR Credit 6	"Rapidly Renewable Materials"
EQ Credit 1	"Carbon Dioxide Monitoring"

EA Credit 2 - "On-Site Renewable Energy"

Overview

The goal of this credit is to promote the use of on-site renewable energy in order to reduce environmental and economic impacts that are often associated with the use of fossil fuels.

There are two ways to satisfy this credit and they are:

1. Use the building annual energy cost calculated in EA Credit 1
2. Use the Department of Energy (DOE) Commercial Buildings Energy Consumption Survey (CBECS) database to determine the estimated electricity use.

Either one of these methods listed above may be used to satisfy the requirements for this credit.

Per LEED-NC 2.2, it is possible to achieve a maximum of 3 points in this category depending on the percentage of renewable energy that the implemented system provides.

% Renewable Energy	Points
2.5%	1
7.5%	2
12.5%	3

Implementation

To achieve this credit, the schematic BIPV system that was discussed as part of the electrical depth shall be used as a basis for determining if it may be possible to achieve points in this area. Since the energy simulation model that was used to calculate EA credit 1 was not available, method 2 shall be used. This is illustrated below:

Location/ Type: California, Educational Facility
Building Area: 68,413 sf

Default Annual Electrical Costs = Building Area x Energy Consumption Intensity* x Energy Costs
= 68,413 sf x 6.6 kWh/sf-yr x $0.18321/kWh
= 451,525 kWh/yr x $0.18321/kWh
= $82,724.04 (A)

Default Annual Fuel Costs = Building Area x Energy Consumption Intensity* x Energy Costs*
= 68,413 sf x 525 kBtu/sf-yr x $0.00843/kBtu
= 3,591,683 kBtu/yr x $0.00843/kBtu
= $30,277.88 (B)

Notes:

**Rates per "EIA 1999 Commercial Building Energy Consumption Survey"*

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Default Total Annual Energy Costs = A + B
= $82,724.04 + $30,277.88
= **$113,002**

To qualify for a point, the BIPV system will need to meet at least 2.5% of its annual energy costs. Therefore, it should pay for at least $2825 of the total energy costs of this building. The 58.8 KW BIPV system proposed is expected to produce 87,319 kWh/yr. Therefore:

86,319 kWh/yr x 0.18321/kWh = $15,814.50

($15,814.50 / $113,002) x 100% = **14 %**

Per the above calculations as performed per LEED-NC Version 2.2, the proposed BIPV system will generate enough electricity to cover approximately 14% of the total annual energy costs of this building. An additional 3 LEED points will be earned since the performance of the proposed system exceeds the 12.5% cap.

MR Credit 6 - "Rapidly Renewable Materials"

Overview

The goal of this credit is to encourage the use of rapidly recyclable materials as opposed to finite raw materials for construction. By LEED's definition, these are materials that are "made from plants that are typically harvested within a ten-year cycle or shorter".

To satisfy this credit at least 2.5% of the total value of all building materials and products used in the project must be rapidly renewable. This value is based on cost.

Implementation

As the total material cost for the project is not available, LEED-NC 2.2 allows the value to be approximated by multiplying the total construction cost by 0.45. Therefore:

Total Construction Costs = $18,986,000
Estimated Material Costs = $18,986,000 x 0.45 = $8,543,700

Total Value of Rapidly Renewable Material Required = $8,543,700 x 0.025
= **$213,592.50**

Based on this value, to achieve this credit, all carpet and rubber-tiled floor areas on all levels in the Student Resource Building including the wood floor in the Multipurpose Room shall be replaced with sustainable bamboo flooring. This will equate to the replacement of approximately 20,000 sf of rubber tiles,22,000 sf of carpet and 1718 sf of wood floor in favor of a much more eco-friendly material. The following table provides a summary:

Level	Rubber (sf)	Carpet (sf)	Total (sf)	Cost ($)
1F	5668	4687	10,355	65,519.00*
2F	5215	10,635	15,850	79,250.00
3F	8973	6552	15,525	82,022.00
Total:	**19,856**	**21,874**	**41,730**	**226,791**

***Note:** includes cost of wood floor in the Multipurpose Room.*

The above cost assumes $5/sf for both the rubber tiles and the carpet installation and represents approximately 2.65% of the total material costs for this project. Assuming that bamboo flooring cost $6 per square feet, a value quoted by buildinggreen.com, the total value of the material will be approximately $260,688 and represent 3.05% of the total material costs. As this exceeds the baseline requirement of 2.5% as outlined in LEED-NC 2.2, the project will earn an additional LEED point for this credit if this was implemented.

Bamboo flooring is hard, strong and dimensionally stable and is typically laminated using urea-formaldehyde for extra durability. Nearly all of the bamboo used in the United States comes from the southern Chinese province of Hunan, an area with very extensive bamboo forests. Bamboo shoots qualify as a rapidly renewable material because they are typically harvested in as soon as 3 years when the shoots reach maturity.

The proposed flooring alternative is called “Plyboo” and shall come from a manufacturer called Smith & Fong based out in San Francisco, California.

Note: *For more information regarding this product, please consult Appendix F.*

EQ Credit 1 - "Carbon Dioxide Monitoring"

Overview

The goal of this credit is to provide a means to monitor the ventilation system to help sustain occupant comfort and well being by introducing CO_2 monitors at key locations throughout the building.

There are two methods of satisfying this credit depending on how a space is ventilated and they are as follows:

1. Mechanically Ventilated Spaces*

a. Monitor carbon dioxide concentrations within all densely occupied spaces (those with a design occupant density greater than or equal to 25 people per 1000 sq ft.) CO_2 monitoring locations shall be between 3 feet and 6 feet above the floor.

b. For each mechanical ventilation system serving non-densely occupied spaces, provide a direct airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2004.

3. Naturally Ventilated Spaces*

Monitor CO_2 concentrations within all naturally ventilated spaces. CO_2 monitoring shall be located within the room between 3 feet and 6 feet above the floor. One CO_2 sensor may be used to represent multiple spaces if the natural ventilation design uses passive stack(s) or other means to induce airflow through those spaces equally and simultaneously without intervention by building occupants.

All monitoring equipment shall generate an alarm when the conditions vary by 10% from the set point via either a building automation system alarm or a visual or audible alert to the building occupants.

Note: **Adapted from "LEED-NC 2.2 Reference Guide".*

Implementation

To determine what method of ventilation system would be appropriate in different areas of this building, it is first important to determine the occupant densities in the different spaces and the corresponding monitoring device to be implemented. To do so, expected occupancy data was taken from the code analysis section of the construction documents. Based on the baseline occupant density of 25 occupants per 1000 sf per ASHRAE 62.1, the following table summarizes the results:

Installation Summary

Equipment Type	1F	2F	3F	Totals
CO_2 Monitors	20	10	22	52
Airflow Measurement Devices	29	57	30	116

Note: *For a complete table of results, please consult Appendix F.*

52 CO_2 monitors and 116 airflow measurement devices will need to be installed. For the later, the credit requires that the device is capable of measuring the minimum outdoor airflow rate with a +/- 15% accuracy per ASHRAE 62.1 requirements. These rates are shown below:

Educational Facility

Occupancy Category	Combined Outdoor Air Rate (cfm/person)
Lecture classroom	8
Computer lab	15
Multi-use assembly	8

To effectively monitor CO_2 concentrations, demand-controlled ventilation systems (DCV) shall be implemented. By doing so, the amount of outdoor air supplied to a space is optimized depending on the occupancy level of the space. The system registers the occupant contribution to the CO_2 concentration in the space and then adjusts the outdoor air ventilation rate accordingly. An analog signal is from the monitor is sent to a signal converter that scales the output and converts it to a signal that is compatible with the damper actuators in the AC unit. Hence, in the event a space is not occupied, this rate can be reduced. All required CO_2 monitors shall be installed in the breathing zone between 3-6 feet above the floor and respond to a maximum value of 1000ppm and a minimum ambient value of 400ppm. ,

For ventilation airflow monitoring, airflow monitoring stations shall be located at the outdoor air intakes of each central HVAC system in this facility and make the necessary adjustments to the air intake rate to provide the necessary levels in the space per ASHRAE 62.1

The equipment that shall be specified include the General Electric “Ventostat® Wall Mount” CO_2 ventilation and be installed during the commissioning process to ensure they are calibrated correctly. Taking this pre-described course of action shall award the Student Resource Building with an additional LEED point for this credit.

Note: *Please consult Appendix F for product specifications.*

Evaluation

The preceding analysis of the select LEED credits discussed in this section showed that it would have been possible for this building to gain a LEED platinum status. By proceeding with these recommendations, an additional 5 LEED points can be expected, bringing the total to 55. For platinum status, a minimum of 52 is required.

It is understood that there will be a significant increase in first cost associated with the implementation of these recommendations but one must consider the long-term benefits, economical and environmental, associated with them. The PV system will reduce the building’s reliance on power from the utility, which typically comes from traditional fossil fuels. By replacing the floor material with bamboo, we are encouraging the use of materials that are rapidly renewable. Last but not least, the implementation of CO_2 monitors will ensure optimum air quality for building occupants.