

Analysis 1: LEED Certification

Introduction

School boards and school districts are hesitant to support the construction of a green and sustainable building. It is thought that there is a large increase in initial costs of the building when that is not necessarily the case. The earlier it is decided that the building will attempt to become LEED certified, the less it tends to affect the initial costs of the project. Even if initial costs are slightly higher than non-LEED certified buildings, the lifetime savings are greater and the owner will save money over time during the use of the building.

LEED Certification was not sought after when constructing a new elementary school for Pasadena. The following research shows which credits could have been sought after to achieve a minimum of a LEED Certified Rating for the elementary school.

29 credits is the minimum for a certified building and it is what will be sought after in this study. Below are the credits that have been selected to be sought after that would minimally affect construction cost and sequencing. Following each in parenthesis is the amount of credits that can be obtained if the credit is earned.

Please see Appendix C for a LEED Credits Summary Sheet.

Sustainable Sites (SS)

SS Prerequisite 1: Construction Activity Pollution Prevention

Erosion during construction is caused by foot traffic that can kill vegetation on existing construction sites. Proper measures can be taken for sediment control to prevent this during construction. Site plan drawings showing proper erosion and sedimentation control measures were already included in the original construction documents. To achieve this credit nothing else needed to be done on this project.

SS Prerequisite 2: Environmental Site Assessment

A Phase I Environmental Site Assessment of the construction site as stated in ASTM E1527-05 must be performed to make sure that the site is not contaminated.

SS Credit 1: Site Selection (1)

It shall be confirmed that the site does not meet any of the following:

- Prime farmland
- It's elevation is lower than 5 feet above the elevation of 100-year flood (defined by FEMA) on previously undeveloped land

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- Land is not reserved for habitat for endangered species
- Whichever is more stringent: within the proximity of 100 feet of wetlands or within setback distance of wetland defined by local authorities
- Land within 50 feet of a major body of water
- Land was not prior parkland

The construction site did not meet any of the above criteria.

SS Credit 4.4: Alternative Transportation Parking Capacity (1)

A new parking plan will be designed that will not be greater than the minimum local zoning code capacity. Also preferred parking will be given to vehicles that carpool for 5% of the total number of vehicle spaces.

SS Credit 5.1: Site Development: Protect or Restore Habitat (1)

This project site has previously been constructed on and to qualify for this credit a minimum of 50% of the site area must contain native or adapted vegetation. However if 75% is achieved an exemplary performance credit can be earned. This vegetation can be included in the greenroof that will be designed for the building.

The following criteria need to be given in order to receive credit:

- Provide the project site area
- Provide the project building footprint area
- Provide a narrative describing the project’s approach to this credit. Include information regarding any special circumstances or considerations regarding the project
- Provide the area (sq. ft.) of the site that has been restored using native and/or adaptive planting
- Provide a copy of the project’s site/landscape plan that provides information regarding the restored site area and the planting materials

Below is the extent to which the current design of the project site applies to this credit. Notice that more measures need to be taken in order to comply.

Project site area is 14 acres =	609,840 sq. ft.
Building footprint area =	<u>- 49,280 sq. ft.</u>
	560, 560 sq. ft.
	x <u> 0.5</u>
Minimum of Native Adaptation	280,280 sq. ft.

Since the project was previously developed, 280,280 square feet needs to be restored with native or adaptive vegetation.

The current Forest Conservation Plan in the construction documents is laid out below:

Area to be retained =	30,928 sq. ft.
Area to be reforested =	74,052 sq. ft.
Total Area Currently Conserved =	104,980 sq. ft.
Minimum Native Adaptation =	280,280 sq. ft.
Total Area Currently Conserved =	<u>- 104,980 sq. ft.</u>
Area needs to be added =	175,300 sq. ft.

In order to meet the requirements for this LEED Credit a total of 175,300 sq. ft. needs to be added to the current Forest Conservation Plan.

SS Credit 5.2: Site Development: Maximize Open Space (1)

The local zoning open space requirement for the site must be exceeded by 25% with vegetated open space. Landscape drawings need to be performed that will highlight the vegetated open space.

SS Credit 7.1: Heat Island Effect: Non-Roof (1)

50% of the site's hardscape areas will be covered with shade or have a Solar Reflective Index of at least 29 to reduce heat islands. A site plan will be made showing both the shaded areas and where materials with a SRI of at least 29 are located.

SS Credit 7.2: Heat Island Effect: Roof (1)

The greenroof design will need to have at least 50% vegetation to receive this credit.

SS Credit 8: Light Pollution Reduction (1)

Requirements for this credit affect both interior and exterior lighting supply. For interior lighting automatic devices (shutoffs) must be supplied for all non-emergency lights.

For exterior lighting the lighting power density needs to be calculated using the fixture wattage. The lighting power density must comply with the following: 80% of lighting power density for exterior areas must not be exceeded and 50% for building's facades and landscape features. This will be done by creating a site illumination model using computer software.

The sports field lighting is not included in the exterior lighting. However, they must have an automatic shutoff device.

SS Credit 9: Site Master Plan (1)

This credit can be met because the following credits were gone after and will have been met:

- Credit 1 Site Selection
- Credit 5.1 Site Development, Protect or Restore Habitat
- Credit 5.2 Site Development, Maximize Open Space
- Credit 7.1 Heat Island Effect, Non-Roof
- Credit 8 Light Pollution Reduction

In addition, the master plan must be made in agreement with the Anne Arundel County School Board.

Water Efficiency (WE)

WE Credit 1.1: Water Efficient Landscaping: Reduce by 50% (1)

This credit can be earned with the help of the greenroof. A rainwater harvesting system needs to be designed and then the water collected can be reused in the building. In addition irrigation efficient practices will be put in place to reduce potable water use for landscaping by 50%.

Although the rainwater harvesting system may require initial costs, the savings of this system will be far greater as the building continues to be used.

WE Credit 3.1: Water Use Reduction: 20% Reduction (1)

The rainwater harvesting system discussed above will aid in this credit as well. If needed, high-efficiency plumbing fixtures will be used in the building's design to reduce water usage 20%.

Energy & Atmosphere (EA)

EA Prerequisite 1: Fundamental Commissioning of the Building Energy Systems

The following is required for this prerequisite:

- A Commissioning Authority shall oversee the commissioning process
- The owner shall create an Owner's Project Requirements and the design team shall develop a Basis of Design report
- Commissioning requirements need to be coordinated with construction documents
- A commissioning plan must be developed and implemented
- The installation and performance of the systems to be commissioned must be verified
- A summary commissioning report must be created

EA Prerequisite 2: Minimum Energy Performance

It must be confirmed that the project meets ASHRAE Std. 90.1-2004 requirements.

EA Prerequisite 3: Fundamental Refrigerant Management

It must be confirmed that the project has a phase-out plan for any CFC-based equipment from the existing elementary school. Also anything new must not use CFC refrigerants.

EA Credit 1: Optimize Energy Performance (2-10)

A whole building energy simulation needs to be performed using computer software. Energy cost savings will be found by comparing Pasadena Elementary School to a baseline building performance rating. Based on the percentage of energy savings, different amounts of credits can be earned.

EA Credit 3: Enhanced Commissioning (1)

In addition to EA Prerequisite 1 the following steps must be taken to receive this credit:

- An independent Commissioning Authority must be hired
- The commissioning authority must review the Owner's Project Requirements and the Basis of Design documents
- The commissioning authority shall review contractor submittals for systems being commissioned
- A systems manual shall be developed
- The requirements for training personnel such as the maintenance staff for the elementary school must be verified
- The commissioning authority shall review with the owner the building's performance 8-10 months after the building has been turned over

EA Credit 4: Enhanced Refrigerant Management (1)

Refrigerants will be selected that comply with the following formula:

$$LCGWP + LCODP \times 10^5 \leq 100$$

Refrigerants meeting the above criteria will be low in Ozone Depletion Potential and Global Warming Potential. The current systems in the building require R22 which is a single hydrochlorofluorocarbon (HCFC) compound. It has low chlorine content and ozone depletion potential and only a modest global warming potential.

$$ODP = 0.05$$

$$GWP = 1700$$

Below are the assumptions made for the following calculations:

- Equipment has a lifetime of 15 years.

- Lr (Leakage Rate) assumed 2%
- Mr=10%

$$\text{LCODP} = [\text{ODPr} \times (\text{Lr} \times \text{Life} + \text{Mr}) \times \text{Rc}] / \text{Life} = 0.04 \times (0.02 \times 15 + 0.1) \times 1.6 / 15 = \mathbf{17.06}$$

$$\text{LCGWP} = [\text{GWPr} \times (\text{Lr} \times \text{Life} + \text{Mr}) \times \text{Rc}] / \text{Life} = 1780 \times (0.02 \times 15 + 0.1) \times 1.6 / 15 = \mathbf{75.95}$$

$$\text{LCODP} + \text{LCGWP} = \mathbf{17.06 + 75.95 = 93.01}$$

It was determined that the current AHUs had too high of refrigerant charge therefore new equipment needs to be chosen.

EA Credit 5: Measurement & Verification (1)

A Measurement and Verification plan must be developed and implemented. It shall be at least one year in length. This plan includes the evaluation of energy efficiency of the actual building to the baseline performance and can be done with the aid of computer software. Metering equipment needs to be installed in order to monitor and document the energy used by the building.

EA Credit 6: Green Power (1)

35% of the building's electricity shall come from a renewable energy resource from a local provider. There shall be a contract of at least two years in length.

Materials & Resources (MR)

MR Prerequisite 1: Storage and Collection of Recyclables

All office paper, cardboard, glass, plastic and metals needs to be recycled during construction.

MR Credit 1.1: Building Reuse: Maintain 75% of Existing Walls, Floors & Roof (1)

This project could have been a renovation of the existing elementary school. If that route was chosen, the calculation of the existing building being reused can be found. If the percentage reaches 95% an additional credit can be earned.

MR Credit 2: Construction Waste Management: Divert from Disposal (1-2)

Calculations will be performed to find how much waste from the construction site can either be recycled or salvaged. If 50% is reached one credit is earned and if 75% is reached two credits can be earned. Materials to be recycled can include but is not limited to: metal, plastic, wood, masonry, corrugated cardboard concrete and glass.

MR Credits 3.1/3.2: Material Reuse (1-2)

A percentage (based on cost) will be found for the amount of materials that can be reused from the existing elementary school. If 5% is found, one credit is earned and two credits are earned if 10% is found.

MR Credits 5.1/5.2: Regional Materials Extracted, Process & Manufactured Regionally (1-2)

If materials used for the building are extracted, processed or manufactured within 500 miles of the project site, they can qualify for this credit. If 10% of the total materials are local one credit is earned. If 20% are used two credits are earned. This credit would not include much extra effort in order to be met; only chosen different manufacturers for materials would have been necessary.

MR Credit 7: Certified Wood (1)

If 50% of the wood used in the project is FSC (Forest Stewardship Council) certified this credit can be earned.

Indoor Environmental Quality (EQ)

EQ Prerequisite 1: Minimum IAQ Performance

The minimum requirements of sections 4-7 of ASHRAE 62.1-2004 must be met based on the building's ventilation design.

EQ Prerequisite 2: Environmental Tobacco Smoke (ETS) Control

Smoking both first hand and second hand has been proven to have a negative effect on people's health. Children can especially be affected in a negative way.

To comply with this prerequisite, there will be no smoking in Pasadena Elementary School. Any smoking must be done at predetermined smoking stations at least 25 feet away from all entryways, outdoor air intakes and operable windows.

EQ Prerequisite 3: Minimum Acoustical Performance

Classrooms must be designed to meet reverberation time requirements as stated in ANSI Standard S12.60-2002, Acoustical Performance Criteria, Design Requirements and Guidelines for Schools. In addition classrooms must have a sound transmission class rating of at least 35. A maximum background noise for classrooms is 45 dBA.

EQ Credit 3.1: Construction IAQ Management Plan: During Construction (1)

During construction the following requirements must be met:

- Control Measures of the Sheet Metal and Air Conditioning Contractors National Association IAQ Guidelines for Occupied Buildings under Construction, Chapter 3 must at least be met
- Absorptive materials must be protected from moisture damage
- Filtration material must have a MERV rating of 8 or greater
- No smoking inside the building or within 25 feet of the building perimeter

EQ Credit 4: Low-Emitting Materials (1-4)

The following options will be sought after for materials earning four credits:

- Adhesives & Sealants must meet the requirements of California Department of Health Services *Standard Practice for the Testing of Volatile Organize Emissions from Various Sources Using Small-Scale Environmental Chambers*
- Paints & Coatings must meet the requirements of California Department of Health Services *Standard Practice for the Testing of Volatile Organize Emissions from Various Sources Using Small-Scale Environmental Chambers*
- Flooring Systems must meet the requirements of California Department of Health Services *Standard Practice for the Testing of Volatile Organize Emissions from Various Sources Using Small-Scale Environmental Chambers*
- Furniture & Furnishings must be GREENBUARD Children & Schools CertifiedSM

These credits can be achieved by choosing materials of the above nature that would not be odorous or irritating to the occupants of the building. Therefore no extreme measures would have been necessary to comply.

EQ Credit 5: Indoor Chemical & Pollutant Source Control (1)

The following measures must be taken for this credit:

- Permanently installed grates, grilles or slotted systems with cleaning allowed underneath must be located at entryways
- Exhausting spaces where hazardous gases or chemicals are present at least 0.5 cfm/sq. ft.
- Filtration media must have a MERV value of at least 13
- Hazardous liquid wastes must have separate containment drains for appropriate disposal

EQ Credit 8.1: Daylight & Views: Daylighting (1-3)

Classrooms having 75% of daylight needs to be achieved for one credit. If 90% is reached or 75% daylight in all areas of the building, additional credits can be earned.

EQ Credit 9: Enhanced Acoustical Performance (1-2)

Background noise in classroom spaces will have a maximum of 35 dBA for 2 credits earned. This is measured by using the Standard S12.60-2002.

Conclusions

If the above set of credits is met, a minimum of 29 credits would have been earned which is the minimum amount needed for a building to be LEED Certified. Additional credits could be earned due to exemplary performance points in certain credit's criteria or project specific innovation credits that designers or contractors may have come up with. A maximum of 46 credits could have been earned if such exemplary performance points were gone after. Although unlikely, if 46 credits were earned the building could be LEED Certified Gold which is an excellent rating.

Measures were not taken to determine the full amount of time or if any additional costs would have been needed for a LEED Certified building. However, it is clear in the research above that achieving LEED credits and certain criteria can have many environmental benefits as well as cost savings throughout the lifetime of the building.

When it comes down to it, the earlier in the project's life that the decision is made to attempt to end up with a LEED Certified building, the better off the project will be. That way as the building is being designed and each part of the project team is performing their job, they can incorporate LEED strategies into the building and a better plan for design and construction can be obtained. Also, as a construction plan is coming into development, the contractors can know what measures they will have to take in order to achieve the criteria set by the design team. This coordinated effort cannot be successful if it decided after the building's design that the goal is to become a LEED Certified building.