A Case Study on Achieving Living Building Challenge Certification on the UCSD Triton Project

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This paper consists of a case study conducted on the UCSD Triton Pavilion project, In San Diego, California. The general contractor on this project is PCL Construction in contract with LMN architecture. The case study evaluates the strategies proposed to help this progressive design build project achieve a Living Building Challenge certification and the costs that would be associated with such implementations. Research and communication with integral employees from PCL Construction helped identify key strategies that ultimately caused the project to not pursue LBC certification and opt to choose a LEED platinum certification instead. In summary the size and scope of the project created too many complexities for the proposed strategies to effectively be applied to a building of this size and scale. Further, the case study revealed the aspects of LEED platinum which made it more feasible for a building of this size and scope. The Living Building Challenge certification would be a substantial risk for both the owner and contractor due to the cost of implanting the LBC principles to a project of this magnitude.

Key Words: Sustainability, Complexity, LBC, Value, Risk

Introduction

The Living Building Challenge and LEED

Before beginning it is the opinion of this paper that there should be provided considerable information regarding both Leadership in Energy and Environmental Design (LEED) achievement and Living Building Challenge (LBC) achievements and their main differences.

Both levels of achievement are handed out by third party rating agencies upon satisfaction of their respective requirements. While both agencies seek to promote the growth of sustainable design and building in the built environment there are significant differences in “levels” of achievement.

LEED established in 1993, has evolved significantly and is now on their fourth version of their rating system LEEDv4. Their official mission is to transform the way buildings and communities are designed, built, and operated, enabling an environmentally and socially responsible, prosperous environment that improves the quality of life.

LEED scores are based on two main aspects, prerequisites and credits. LEED has 6 main categories. Location and Transportation, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources and Indoor Environmental Quality. They also have two additional categories in Innovation, and Regional Priority that project teams can apply to earn extra credits in.

In each of these categories there are prerequisites, or certain strategies that must be met in order to score points in that category. There are additional credits that can be achieved in each category to earn more points. Accumulating these prerequisites and credits yield the final score and certification of the building. The breakdown is out of 110 points and as follows

Certified: 40-49 Points

Silver: 50-59 Points

Gold: 60-79 Points

Platinum: 80+ Points

An example of a LEED scorecard is displayed in Figure 1 (LEEDing Green).

LEED v4 for BD+C: New Construction and Major Renovation
Project Checklist

Project Name:
Date:

Y	?	N			
			Credit	Integrative Process	1
0	0	0		**Location and Transportation**	**16**
			Credit	LEED for Neighborhood Development Location	16
			Credit	Sensitive Land Protection	1
			Credit	High Priority Site	2
			Credit	Surrounding Density and Diverse Uses	5
			Credit	Access to Quality Transit	5
			Credit	Bicycle Facilities	1
			Credit	Reduced Parking Footprint	1
			Credit	Green Vehicles	1
0	0	0		**Sustainable Sites**	**10**
Y			Prereq	Construction Activity Pollution Prevention	Required
			Credit	Site Assessment	1
			Credit	Site Development - Protect or Restore Habitat	2
			Credit	Open Space	1
			Credit	Rainwater Management	3
			Credit	Heat Island Reduction	2
			Credit	Light Pollution Reduction	1
0	0	0		**Water Efficiency**	**11**
Y			Prereq	Outdoor Water Use Reduction	Required
Y			Prereq	Indoor Water Use Reduction	Required
Y			Prereq	Building-Level Water Metering	Required
			Credit	Outdoor Water Use Reduction	2
			Credit	Indoor Water Use Reduction	6
			Credit	Cooling Tower Water Use	2
			Credit	Water Metering	1
0	0	0		**Energy and Atmosphere**	**33**
Y			Prereq	Fundamental Commissioning and Verification	Required
Y			Prereq	Minimum Energy Performance	Required
Y			Prereq	Building-Level Energy Metering	Required
Y			Prereq	Fundamental Refrigerant Management	Required
			Credit	Enhanced Commissioning	6
			Credit	Optimize Energy Performance	18
			Credit	Advanced Energy Metering	1
			Credit	Demand Response	2
			Credit	Renewable Energy Production	3
			Credit	Enhanced Refrigerant Management	1
			Credit	Green Power and Carbon Offsets	2
0	0	0		**Materials and Resources**	**13**
Y			Prereq	Storage and Collection of Recyclables	Required
Y			Prereq	Construction and Demolition Waste Management Planning	Required
			Credit	Building Life-Cycle Impact Reduction	5
			Credit	Building Product Disclosure and Optimization - Environmental Product Declarations	2
			Credit	Building Product Disclosure and Optimization - Sourcing of Raw Materials	2
			Credit	Building Product Disclosure and Optimization - Material Ingredients	2
			Credit	Construction and Demolition Waste Management	2
0	0	0		**Indoor Environmental Quality**	**16**
Y			Prereq	Minimum Indoor Air Quality Performance	Required
Y			Prereq	Environmental Tobacco Smoke Control	Required
			Credit	Enhanced Indoor Air Quality Strategies	2
			Credit	Low-Emitting Materials	3
			Credit	Construction Indoor Air Quality Management Plan	1
			Credit	Indoor Air Quality Assessment	2
			Credit	Thermal Comfort	1
			Credit	Interior Lighting	2
			Credit	Daylight	3
			Credit	Quality Views	1
			Credit	Acoustic Performance	1
0	0	0		**Innovation**	**6**
			Credit	Innovation	5
			Credit	LEED Accredited Professional	1
0	0	0		**Regional Priority**	**4**
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
			Credit	Regional Priority: Specific Credit	1
0	0	0		**TOTALS** Possible Points:	**110**

Certified: 40 to 49 points, **Silver:** 50 to 59 points, **Gold:** 60 to 79 points, **Platinum:** 80 to 110

Figure 1. Example of LEED Scorecard (LEEDv4)

The Living Building Challenge established in 2009 has taken much of the sustainable standards developed over the years and re-vamped them significantly, they are also on their fourth version LBCv4. (International Living Future Institute).

LBC's goal is to make the world work for 100% of humanity in the shortest possible time through spontaneous cooperation and without ecological offense or the disadvantage of anyone. In their own executive summary, they admit the LBC is an attempt to dramatically raise the bar from the paradigm of doing less harm, to one in which we view our role as a steward and co-creator of the living future.

Like LEED, the LBC applies a sort of prerequisite and credit system named alternatively as Core Imperatives and Normal Imperatives. Core Imperatives is what is required to be met and all other additional imperatives are sort of "options". LBC has 7 main categories, Place, Water, Energy, Health and Happiness, Materials, Equity, and Beauty. Although boasting different names they largely cover the same main topics as LEED. However, LBC differs greatly from LEED in the sense that there are no points in their levels of achievement, rather compliance, or noncompliance. As seen in figure 2 in order to obtain Full LBC certification ALL imperatives must be met. Petal Certifications are awarded if all core imperatives are met in addition to the remaining imperatives in a specific category. The Core achievement is just that, a building that meets all core imperatives. An example of the different LBC certifications is shown in figure 2.

Figure 2. Example of LBC Certifications (LBCv4)

Additionally, LBC imperatives are generally harder to achieve. Some examples include LBC's attention to real performance, a building must be operating for a full year before applying for LBC accreditation while LEED can award certification before a building is even complete. LBC requires that a project produce 105% of a building's energy needs while the highest level of LEED requires 75% reduction in energy from a buildings baseline (International Living Future Institute). Several more of these differences, and the implementation of the strategies to achieve them will be the topic of this paper.

In synthesis, it is the opinion of this paper that the difference between LEED and LBC can be summarized as LEED's goals seek to do less harm while LBC seeks to fix the damage.

UCSD Triton Pavilion

The UCSD Triton Pavilion for Student Resources and Community Engagement is designed to support enrollment growth and consolidate complementary programs and services including Student Health and Wellbeing, Alumni and Welcome Center, campus support, campus bookstore, retail, and restaurant/ food services. The buildable site area is approximately 3.9 acres with four planned buildings boasting 350,000 GSF.

During schematic design performing contractor PCL Construction, LMN Architects and UCSD collaborated in a Progressive Design Build contract to establish the building program and budget. Part of this program included a in depth look into the Sustainable Goals and possible accreditations. As a baseline the project team agreed that LEED Platinum accreditation would be sought after. Yet, UCSD's past commitment to Sustainability prompted them to evaluate the possibility of achieving either full Living Building Challenge accreditation or the Living Building Challenge Energy Petal.

Methodology

Purpose

The purpose of this paper is to explore the different strategies a project like the UCSD Triton Project would need to implement to achieve the LBC accreditation and evaluate the value of each of these strategies to the project team.

Through a case study of the UCSD Triton LEED Platinum vs LBC gap analysis, and in coordination with PCL Construction this paper identifies key strategies that greatly affected the decision to not pursue LBC accreditation.

The Investigation

The investigation begins with a deep look into the Gap analysis to fully understand the implications of all the strategies proposed to meet each imperative of the LBC. This included creating a scoring matrix of the strategies, the score is the value of the strategy and includes the amount of sustainable benefits the strategy offers, the costs of each strategy, the ease of implementation, and operations and maintenance considerations. Each of these considerations was scored, the scoring criteria is given below.

Scoring Criteria

Benefits: 1,2,3,4,5. Possible Benefits of Strategy (Equity Benefit, Climate Benefit, Ecosystem Benefit, Local Benefit, Health benefit)

First Costs: 1,3,5. 1= < $1 Million, 3= $1-$5 Million, 5 = > $5 Million

Ease of Implementation: 1,3,5. 5= Easy to Implement, 3= Some Increased Consideration to Implementation, 1= Complex to Implement

Operations and Maintenance: 1,3,5. 5=Easy to Implement, 3= Some Increased Consideration to Implementation, 1=Complex to Implement

It is important to note that for the sake of this scoring criteria, each of the four considerations are weighted equally. Each project, project team, and project team member will weigh these four considerations differently but for the sake of this case study we have assumed equal weight of considerations. The maximum score a strategy could achieve is 100. Each consideration is multiplied by 5 as a constant to achieve a maximum possible score of 25 per each consideration.

For example:

100 = (5 Possible Benefits X 5 weighting score) + (5 = > $5 Million Cost X 5 weighting score) + (5=Easy to Implement strategy X 5 weighting score) + (5=Easy to Implement O&M X 5 weighting score).

These values are assigned based on a combination of PCL's evaluation of each strategy and evaluation of this paper. The scores are based on each individual strategy but also divided into their respective LBC categories. Identifying key outliers in scores and evaluating the overall total score, this paper identified and communicated with key PCL employees that worked closely with the UCSD Triton Project to understand why some strategies scored better than others and how these strategies affected the consensus of the project team to not attempt LBC accreditation.

Results/Analysis

The results from the scoring matrix are provided below, they contain a summary of the strategy and the scores in each of the four qualifiers or considerations.

Table 1

Scoring Matrix for Energy Strategies

Strategy	Environmental Benefits	First Costs	Ease of Implementation	Operations and Maintenance	Value Score
Energy					
Reduce embodied carbon in materials	2	5	3	5	75

Onsite renewable energy production	1	2	1	5	45
All electric and energy efficient mechanical systems	1	2	3	5	55
Resilience strategy	1	3	3	5	60
Average Energy Score					58.8

Table 2

Scoring Matrix for Water Strategies

Strategy	**Environmental Benefits**	**First Costs**	**Ease of Implementation**	**Operations and Maintenance**	**Value Score**
Water					
Stormwater Management	1	5	5	5	80
Rainwater capture and reuse	1	5	3	5	70
Grey and blackwater treatment and reuse	1	3	1	3	40
Recycled Water for irrigation	1	5	3	5	70
Vacuum-flush toilets	1	3	3	3	50
Average Water Score					62

Table 3

Scoring Matrix for Material Strategies

Strategy	**Environmental Benefits**	**First Costs**	**Ease of Implementation**	**Operations and Maintenance**	**Value Score**

Materials					
Low-emitting materials	1	5	5	5	80
Toxic Ingredient transparency	3	3	1	5	60
FSC Certified wood	1	5	5	5	80
Regional Materials	1	5	3	5	70
Salvaged Materials	3	5	3	5	80
Construction Waste Diversion	2	5	1	5	65
Design for deconstruction	1	5	3	5	70
Operational waste management	1	5	5	5	80
Average Materials Score					73.1

Table 4

Scoring Matrix for Place Strategies

Strategy	Environmental Benefits	First Costs	Ease of Implementation	Operations and Maintenance	Value Score
Place					
Landscape design	2	5	3	3	65
On-site food production	3	5	3	1	60
Wilderness preservation	1	5	5	5	80
Electric vehicles	2	5	5	5	85
Bicycle facilities	3	5	5	5	90
Reducing single	2	5	5	5	85

occupant vehicles					
Average Place Score					77.5

Table 5

Scoring Matrix for Health and Happiness Strategies

Strategy	**Environmental Benefits**	**First Costs**	**Ease of Implementation**	**Operations and Maintenance**	**Value Score**
Health and Happiness					
Indoor Air Quality	2	3	3	1	45
Thermal comfort	2	5	5	5	85
Daylight and views	1	5	3	5	70
Green cleaning	1	5	5	5	80
Connection to nature	1	5	5	5	80
Average Health and Happiness Score					72

Overall Average Score	**68.7**

Upon deeper analysis and communication with PCL employees this paper identifies several key strategies that hinder the attempt at LBC accreditation. Namely, the onsite renewable energy sources and the vacuum flush toilets.

In talks with Adrian Ayala, the estimator responsible for the schematic estimates for the Triton project, he and this paper establish that in order to meet the LBC demand the project needed to incorporate an additional 70,000 SF of PV panels. All of the horizontal surfaces were already designed for PV panels and the project team was forced to evaluate vertical surfaces that was a premium cost for the structural support of the panels. This also impacted the schedule to enclose the building and affected the exterior glazing by creating a more complex design to allow for the steel to penetrate the glazing system and tie back to the structure.

Additionally, to meet the rigorous water use standards of the building, the team suggested to install vacuum flush toilets that tied into a grey and blackwater treatment facility. The scale of the project required additional basement rooms for a mechanical central plant and black water treatment facility. Black water treatment goes underground in order to avoid pumping, which can add additional costs and maintenance. Having a separate basement under each building, rather than on underground system amongst them, added additional costs as well.

But the hesitancy of seeking LBC accreditation spans far beyond the actual construction strategies. With talks with senior management of PCL it ultimately came down to the risk. The overall estimate to push to LBC accreditation was $45 million dollars, roughly an additional 17% of project budget. Considering the overall score of the strategies was a meager 68.7/100 the payoff of 17% extra work was not worth the risk of attempting.

Izary Torres, a Project Engineer who closely works with the Triton project adds that this project had over 200 stakeholders, each department had a say in the project. Certain departments and individuals are used to one way of running things. The LBC brought a change to something they are used to, people who have worked for years at the university and are used to doing things a certain way do not respond well to change. The owners were hoping for a donor to sponsor/donate the additional cost for it to be an LBC project. Many stakeholders are not familiar with the LBC concept or are environmental enthusiasts. Having leadership that is environmentally conscious goes a long way.

Conclusion and Future Research

The findings of this case study identify the key factors that affected the decision to not attempt LBC accreditation. At the end of the day there is a simple yet complex answer, the UCSD Triton project is just too big. Several of the strategies evaluated in this case study are simply too costly and are untested at this magnitude. The risk for both the contractor and the owner from this ambiguity outweighs the desire to make the stretch to LBC.

A project this big with so many uses such as retail, classrooms, restaurants, bookstores, and offices, there are just too many codes, departments, and people involved. It is the opinion of this paper that the LBC has too many criteria to follow that make it hard for a project this big and complex.

At the time of this research, there are 23 full LBC buildings globally. Not a single one of them is more than 150,000SF. Often with size comes complexity and although the LBC is taking strides to improve the environment today and, in the future, it is simply not applicable to projects of this scale. The question now lies in how we can evolve strategies so that all buildings can achieve the highest levels of sustainability. This paper encourages future research and development of practices of sustainable building that can accommodate projects of this scale.

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