

Sustainable Building Techniques in Levi's Stadium: A Case Study

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This study aimed to analyze the sustainability of Levi's Stadium in Santa Clara, California through an analysis of its Leadership in Energy and Environmental Design or LEED certification. Levi's Stadium was the first professional sports stadium to receive LEED Gold certification in 2014, at a time where a focus on green building practices was becoming an industry standard. This analysis aims to determine what avenues the project team employed to ensure certification, including various standout features and strategies. Additionally, the study investigates the scorecard used to award points towards LEED certification, highlighting categories emphasized in design and construction and those that made less of a contribution to the point total. Finally, a more personal and detailed take on the process was collected through an interview with an employee that led sustainability efforts on the project. Through this analysis, the study intends to establish the pathway that a stadium project should take to find success in sustainability. With the information gathered, it was determined that the strategies Levi's Stadium utilized were successful and trailblazing, and further case studies conducted on more recent professional sports stadiums would provide a clearer and more current picture of the recent landscape surrounding the sector.

Key Words: Sustainability, Construction, Green Building, Stadium, LEED

Introduction

Construction projects like Levi's Stadium are a rarity. The magnitude, the manpower, and the attention it brings are only a few of the various aspects that make it a complicated project to complete. One aspect that some may overlook are the sustainability considerations, both during construction and during building operation. Green building is a strategy that has gained a lot of traction over the past decade, and today it is an industry standard to operate with green standards in mind. However, there is a big difference between having sustainability in mind and bringing these green ideas to life. One path to ensuring a tangibly sustainable project is designing and building with LEED certification at the forefront.

LEED Certification

LEED is a building rating system developed by the United States Green Building Council (USGBC). It serves as a guideline for green building within the construction industry. For a building to be certified by the system, it must earn a set number of points in various sustainability categories. These points are displayed on a scorecard and the requirements for each category are laid out clearly.

Different point totals result in different levels of LEED certification: 40-49 points for Certified, 50-59 points for Silver, 60-79 points for Gold, and 80 or more points for Platinum (USGBC 2021).

Additionally, the USGBC features various types of LEED rating systems based on the project being certified. BD+C (Building Design and Construction) covers new construction or major renovations, while ID+C (Interior Design and Construction) grades interior fit-outs. O+M (Building Operations and Maintenance) is for existing buildings, and ND (Neighborhood Development), Homes, and Cities and Communities all rate their respective namesakes (USGBC 2021).

An important note is that these rating systems are updated as the world of green building develops. As of 2022, the current version is LEED v4.1, which has been utilized for almost a decade. While the specific categories may change as new versions are developed, the goals of the system are maintained. The USGBC states that “LEED is a holistic system that doesn’t simply focus on one element of a building...rather it looks at the big picture factoring in all of the critical elements that work together to create the best building possible” (USGBC 2021).

LEED Certification in Stadiums

Earning LEED certification is not an easy task for any project. Therefore, a professional sports stadium, with all of the complications of such a large-scale project, can expect to find it especially difficult. There is no designated LEED rating system for stadium construction, so these projects fall into the aforementioned categories. Stadiums generally use the LEED BD+C rating system, with the version varying depending on when the process was initiated.

Although green building is on an upward trend, a majority of professional sports stadiums were built before it became standard practice. Many stadiums have been around for decades, so minor changes and retrofits to remain efficient are more common than new construction or major remodels.

While these projects may look similar to more common commercial projects on the scorecard, there are naturally massive differences in approach that project teams must navigate, like added visibility to the project. With this added visibility can come external pressure and/or criticism, like claims of “greenwashing”, defined as the “belief that teams are simply doing external, cursory green activities to earn a positive public appearance, while doing little to solve bigger, overall problems” (Grant 2014). This is just one of many aspects that complicates the green building of a stadium rather than other projects.

Levi’s Stadium

Levi’s Stadium is the Santa Clara, California home of the San Francisco 49ers. One of the newest NFL stadiums, Levi’s is seen as a crowned jewel of the sport, hosting the Super Bowl in 2016 and the College Football Playoff National Championship in 2019.

Additionally, Levi’s Stadium was a groundbreaking project in the sustainability sector. It was the first professional sports stadium to receive LEED Gold certification and paved the way for future stadium construction to be held to the same standard. Levi’s had been in the works for decades prior to its opening in 2014 (Levi’s Stadium). The construction was performed as a joint venture between Devcon Construction and Turner Construction, while the architect on the project was HNTB (Kim 2022).

Another important party was Brightworks Sustainability, a nationwide sustainability consulting firm that has been involved with many high-profile projects across the country. They helped to ensure the LEED certification was on track throughout the duration of construction (Kim 2022). Additionally, countless trade partners were involved in the construction on the sustainability side, each providing their own expertise.

Literature Review

To find valuable information for this case study, there are multiple levels of information required. The first and most accessible is the surface level information about the project, including general details of the stadium and the project from various sources. Much of this information can be found on the general Levi's Stadium website, along with the project pages of both general contractors (Devcon Construction and Turner Construction) and the architect (HNTB).

When looking at the project from a sustainability point of view, however, a deeper look is needed. Four main sources were utilized to provide sustainability information. The first is the United States Green Building Council website, which has information on LEED, different rating systems, and anything else pertinent to certification. It also has information on previously certified projects, including Levi's Stadium. This allows for the analysis of the project's LEED scorecard, along with explanations of specific credits within the scorecard. The second source is the sustainability section of the Levi's Stadium website, which provides a short list of sustainable aspects of the stadium to investigate. Next, the Brightworks Sustainability project page gives a detailed description of the project and how green building techniques were utilized throughout. Since Brightworks was a consultant throughout the process, this source is very reliable. Finally, Greenroofs has a write-up on Levi's Stadium, its trade partners, and the sustainability highlights.

Lastly, the project must be looked at from an external viewpoint. So, sources from other writers, some discussing similar topics, were included in the study. Benjamin Riddle wrote a thesis paper called "The Machine in the Arena" in 2019 that includes information on the role of stadiums in their greater communities. Thomas Grant wrote "Green Monsters: Examining the Environmental Impact of Sports Stadiums" (2014), which gives multiple viewpoints on ways that various stadiums can impact the environment as a whole. This source pushes back on the idea that all "green stadiums" are making a positive impact on their surroundings. There is also a short paper written by Henry Anderson in 2014 for Stanford University that has some similar themes as this study without the analysis and commentary. However, it provides a general understanding of what the project accomplished with its sustainability.

Methodology

Scorecard Analysis

Since the USGBC displays the scorecard for their LEED certified projects, Levi's Stadium's path to earning its LEED Gold Certification can be looked at in detail. The LEED BD+C New Construction (v2.2) scorecard contains six different categories that the project can earn points: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Material & Resources, Indoor Environmental Quality, and Innovation.

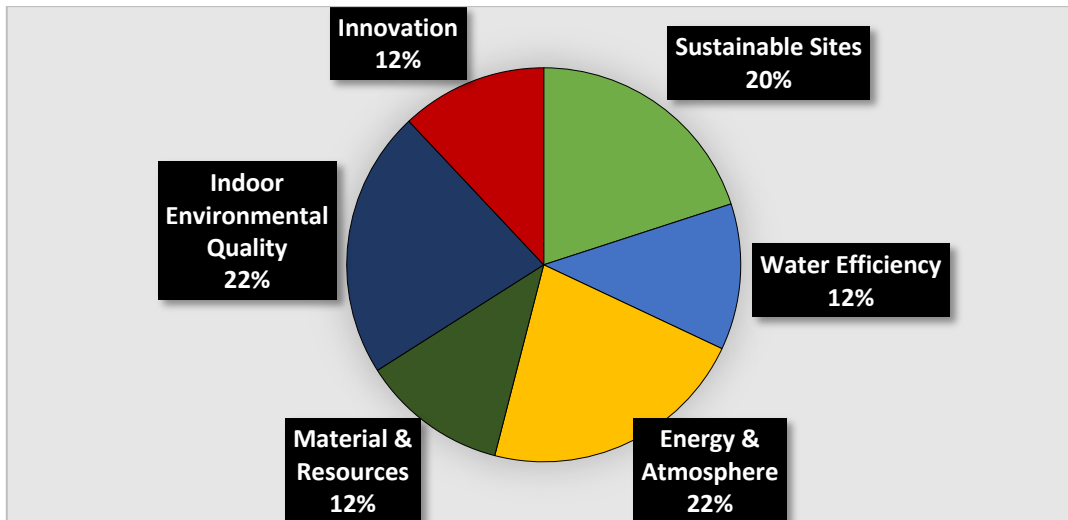


Figure 1. Levi's Stadium LEED Certification Scorecard Point Distribution

This project and its team did well in filling out a balanced scorecard, earning points in each category. Figure 1 displays the distribution of points that each category accounted for (out of the 41 points earned by the project). For example, the Sustainable Sites category was awarded 8 points that go toward the project's total 41, so the category accounts for 20% of the total points awarded

In looking at the chart, it seems to showcase three primary categories that contributed to the point total: Indoor Environmental Quality, Energy & Atmosphere, and Sustainable Sites. In other words, these three categories provided a large majority of the points toward Levi Stadium's LEED Gold Certification. However, this analysis does not take all available points into consideration.

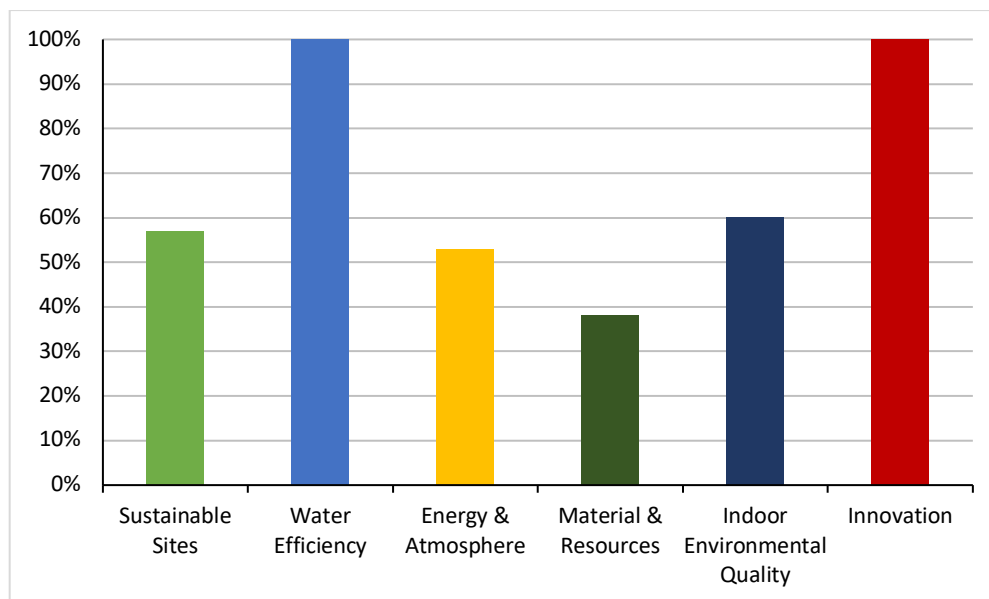


Figure 2. Percentage of Points Earned Within Scorecard Categories

Figure 2 displays the percentage of points that were earned out of points that were available within each category. Here, the data shows that while Water Efficiency and Innovation were not primary contributors to the total volume of points, the two categories saw completion in the point awarding of their respective sections.

This information further highlights the balance between categories on the LEED scorecard. Where three categories led in volume added, two more led in percentage completed. This leaves one category: Material & Resources. The category was only awarded 5 out of 13 possible points (one of which was a required credit), leaving plenty of room for improvement.

Special Considerations

When analyzing this scorecard, it is important to remember the type of project being analyzed. While Levi's Stadium falls under LEED BD+C, there are special considerations for a stadium project that others in the category, like a new office building, would not be overly concerned with.

One of these considerations is the extremely high usage of water and energy. Naturally, an NFL stadium is bound to use monumental amounts of water and energy to achieve its goals. The grass must be watered properly, many sinks and water closets can be found across the venue, and lighting is important both on the field and surrounding it. Therefore, the design called for deeper consideration for both water and energy usage.

Another consideration is the volume at which transportation is utilized in a stadium. A typical commercial building, even if filled by thousands of workers every day, cannot compare to the amount of traffic that Levi's Stadium endures. Not only are there nearly 70,000 seats to fill, there are over 170 suites full of fans, hundreds of media members, and of course, members of the 49ers organization to consider (Levi's Stadium). So, sufficient consideration for transportation is a must.

Sustainable Features & Strategies

Site Location

Perhaps the most important feature of all, the site location does not get the attention of the other marketable aspects. However, the methodical site selection set the tone for the project's sustainability. As alluded to in the scorecard analysis, location (covered in the Sustainable Sites category) contributed multiple points to the total. Half of the points earned in this category involve means of transportation. The stadium's centralized location allows for easy access to public transportation like the VTA (Valley Transportation Authority) Light Rail, VTA bus, and multiple train options. It also provides the ability to ride a bicycle to the stadium due to its proximity to surrounding populated areas (Levi's Stadium).

Green Roof

One of the most recognizable and attractive features of this stadium is the NRG Solar Terrace Green Roof resting above the Tower of Suites. In addition to its visual draw, the area serves as one of the greener aspects of the entire project. The green roof is 27,000 sq. ft. of vegetation, as well as 2,000 tons of dirt that both soak up rainwater and provide some insulation for the suites below it (Anderson

2014). Many of the plant species included are “drought-tolerant”, further solidifying the conservational efforts (Brightworks 2022).

Solar Panels

Levi’s Stadium has 1,186 Photo Voltaic solar panels installed across the stadium, totaling about 20,000 square feet of solar panel coverage. These panels generate 375 kW of power (Greenroofs 2022) and can be found in two primary locations: atop the NRG Solar Terrace that crowns the Tower of Suites (along with the green roof), and on the three pedestrian bridges that connect the stadium area to the adjacent parking lot. “Over the course of a year,” writes David Baker of SFGate, “the panels will generate about as much electricity as the 68,500-seat stadium will consume during its 10 home games” (Baker 2013). This statement goes hand in hand with Brightworks’ assertion that the 49ers home games are net-zero as a result of the solar panel capacity (Brightworks 2022).

Water Usage

Water usage could be dubbed the biggest detriment to the sustainability of many sports stadiums. For example, Lucas Oil Stadium, the home of the Indianapolis Colts, once had a piping situation that led the team to use “a staggering 14 million gallons of water, enough to fill all the outdoor public swimming pools in Indianapolis three times” in a single month (Grant 2015). On this project, the LEED scorecard confirms that a more calculated approach to water usage was used to prevent a similar situation.

Levi’s uses reclaimed water for its flushing and irrigation systems via FlowTherm’s “Recycled Water Booster Pump Systems” that “help the stadium save more than 42 million gallons of water per year (FlowTherm Systems 2022). Additionally, according to Brightworks “the stadium connects to Santa Clara’s recycled water system, making it the first stadium in California to use a drought-proof water source for an impressive 85 percent of all water consumed within the stadium” (Brightworks 2022). This high usage of reclaimed water is a major reason that the project scored so highly in the Water Efficiency category, earning points for up to 30% water reduction.

Industry Interview

To get a more personal and detailed viewpoint on this project, the author was fortunate enough to interview one of the key members of its sustainability team. Kesor Kim is a Project Manager with Devcon Construction, and he led the sustainability efforts for the company during the construction of Levi’s Stadium.

Kim described the focus on green building within this project as “the right thing to do” and something that “made sense”, particularly in the area that the stadium was being built. As mentioned previously, this focus is not a requirement for NFL stadiums, but more of a responsibility of the owners. Kim said that LEED certification was always a goal, and the LEED certification scorecard was established during the design phase (before he was involved with the project). He also credits Brightworks Sustainability, the third-party sustainability consultant, with aiding in keeping tabs on the certification process.

Despite the amount of information available to research, one topic discussed was Kim's perceived highlights of the sustainability aspect of the project. He talked about multiple features previously touched on, like the green roof, the use of reclaimed water, and site selection.

The main takeaways from the interview, however, came when discussing both challenges and potential improvements. For the challenges, Kim mentioned that an important distinction in projects of this type and magnitude are that there are sometimes very specific materials and finishes needed for various reasons. This can make it hard to meet the quota for recycled content, as the goal is not to stray far from its use.

When asked about what improvements could be made if the project were done today, Kim brought up perhaps the most important point of the study. Levi's Stadium was constructed nearly a decade ago and designed long before then. It was also certified with LEED v2.2, as opposed to today's LEED v4.1. There are so many materials, techniques, and guidelines in the industry today that would surely be utilized on any project, like more energy efficient pumps or further optimization of energy. So, it is hard to pinpoint any specific changes that could be made looking back. Kim ended up mentioning the previously identified Material & Resources category on the scorecard, saying that improvements could be made there, specifically with regards to sourcing regional materials.

Results

Success

Levi's Stadium fared extremely well when analyzing its LEED BD+C v2.2 scorecard. As the scorecard analysis shows, the points were spread out fairly well across the various categories. Sustainable Sites, Energy & Atmosphere, and Indoor Environmental Quality added the most points to the total of 41 because the categories are larger than others. On the other hand, Water Efficiency and Innovation added 5 points each, earning 100% of the points available in their respective categories. This highlights the variety that can be found in the sustainable focuses of the project.

The category that did not score as well as the rest was Material & Resources. However, positives can still be found in the category. According to Levi's Stadium, "100% of the wood used in the Citrix Owners Suites is reclaimed wood from a local airplane hangar at Moffett Field in Mountain View, CA". While this may have not paid off on the scorecard, it shows that sustainable efforts were made for reasons other than points and recognition.

The main components of success in this project come in the features discussed: site location, the green roof, solar panels, and water usage. Site location allows for public transportation to be a huge positive, and adds to the communal feeling with the area surrounding the stadium. The green roof provides an aesthetically pleasing way to collect and utilize rainwater while aiding in the insulation of the suites below. The solar panels allow home games to achieve net-zero energy use, a huge feat for such a large venue. Finally, the commitment to using 85% recycled water in a sector that has notably high water usage sets a standard for future stadiums. Levi's shows that it is possible, and that significant savings are being seen as a result. These strategies are all areas that future stadium designers will likely point out as successful features that should be replicated.

Potential Improvements

As Kesor Kim alluded to, a project of this scale goes through intensive design for decades before even thinking of breaking ground. This holds especially true when considering the sustainability of the project. Subsequently, Levi's Stadium accomplished everything on its LEED certification scorecard that it set out to, allowing them to receive the LEED Gold certification that they coveted. This makes it difficult to find any potential changes that would have improved

That being said, an aspect that should be highlighted can be seen within the Material & Resources category on Levi's Stadium's scorecard: Regional materials. In order to gain a point, "a minimum of 10% of the total materials value" must be made up from "materials or products that have been extracted, harvested or recovered, as well as manufactured, within 500 miles of the project site" (USGBC 2022). An additional point can be gained by increasing the amount to 20% of total materials value.

This area is one that Kesor Kim mentioned as one of the main areas that could have been improved upon regarding the sustainability of the project. He mentioned that materials and finishes were very precisely chosen early on in the process, meaning they were decided upon long before construction began in 2012. Now, the industry has countless products and sources for sustainable materials that there was little to no access to when material and finish selection took place.

With these circumstances, it is understandable that an NFL stadium might have to travel outside of a 500-mile radius to obtain many of its materials. However, there are now more avenues to complete this task. If Levi's Stadium were built in the same location in 2022, it is likely that the project team would have a clearer path in earning these credits.

Conclusion

Levi's Stadium achieved almost exactly what the designers and builders envisioned when they set out to create a sustainable stadium that could set an example for future projects of similar magnitudes. The group set a plan with their design and stuck to it, resulting in the first LEED Gold certified professional sports stadium. Especially in a time where green building was more of a welcome addition than an industry standard, Levi's was created with an impressive number of sustainable features and techniques such as the green roof, the high usage of reclaimed water, and high-powered solar panels.

While the project's accomplishments cannot be overstated, it is important to point out the time period in which design and construction took place. Levi's Stadium opened in 2014 after breaking ground in 2012 (Levi's Stadium). However, a project of this size takes years of design, permitting, and plenty of other hurdles to clear before construction can start. As Kesor Kim mentioned in the interview, the design of this stadium had been ongoing for decades even prior to bidding.

As a result, developments in sustainability that the industry has seen over the past decade were not incorporated. This includes anything from more efficient materials and finishes that Kesor Kim mentioned to a greater incorporation of innovative design and technologies (USGBC 2021). Had the project been designed within the past few years, there would naturally be countless updates to fit today's sustainability standards. This makes it difficult to assess potential pathways for the industry to move forward from and build upon current standards because there has been plenty of growth in standards since this stadium was constructed.

Future Research

Based on the information gathered in this study, it would be valuable to conduct a similar study on the sustainability of more recent professional sports stadiums. A case study on Las Vegas' Allegiant Stadium or Los Angeles' SoFi Stadium, two NFL stadiums that have opened within the past five years, may provide information that is more relevant to today's green building landscape. Additionally, both projects would seemingly fall under a much more current LEED version, rather than the rating system that was utilized for Levi's: LEED v2.2.

With a case study of either of these stadiums, or any professional stadiums that open in the future, there would be an avenue to compare the information to that found in this case study. From that point, one could determine the development of the sustainable building process over the given time frame. This could include shifted focuses, added resources, new technology used, and any other relevant information that could be a driving force in the next industry-shifting stadium project.

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