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Is Sustainable Design Financially Unsustainable?

Introduction

This paper uses three different case studies along with evidence from research reports to create the argument that integrating sustainable design does not increase construction costs. It first describes the importance of sustainable architecture in the midst of the current climate emergency, then goes on to discuss what defines sustainable design. The three case studies included exemplify different aspects of sustainable design, utilizing both modern and traditional materials. An analysis of each of the case studies follows which also includes information from research reports on cost analyses of sustainable designs. Overall, this paper emphasizes the importance of sustainable design and debunks the idea that green building is not viable because of its cost.

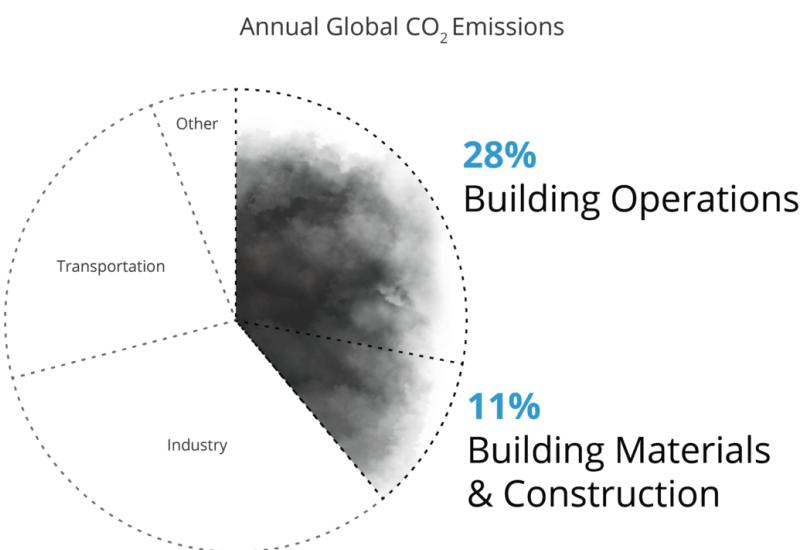
Importance of Sustainable Architecture

Human induced climate change has affected at least 85% of the world's population, and according to the Washington Post, in the United States alone, climate disasters last year caused at least "388 deaths and more than \$100 billion in damage."¹ If the concentration of carbon dioxide in the atmosphere continues to rise, the consequences of climate change will become more severe. According to the World Green Building Council, "buildings are currently responsible for

¹ Annabelle Timsit and Sarah Kaplan, "At Least 85 Percent of the World's Population Has Been Affected by Human-Induced Climate Change, New Study Shows," The Washington Post (WP Company, October 23, 2021), <https://www.washingtonpost.com/climate-environment/2021/10/11/85-percent-population-climate-impacts/>.

39% of global energy related carbon emissions, with 28% being from operational emissions... and the remaining 11% being from materials and construction.”² As construction accounts for a significant portion of greenhouse gas emissions, there has been a push to make buildings more sustainable. In this climate emergency, it is crucial that steps be taken to mitigate our effect on the environment. While recent climate disasters have shown a need for urgency, sustainable building practices still have yet to become the norm.

As the problem of climate change is clear, why hasn’t there been more of a shift in architecture design to promote sustainability? In a survey conducted by the World Business



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Data Sources: Global ABC Global Status Report 2018, EIA

Figure 1: Breakdown of carbon emissions by sector. *Annual Global CO₂ Emissions*, n.d., photograph, *Architecture 2030*, n.d., <https://architecture2030.org/why-the-building-sector/>.

Council for Sustainable Development, it was found that the public on average believed that green features added 17% to the cost of a building.³ The perception that sustainable buildings cost

² “Embodied Carbon Call to Action Report,” World Green Building Council, accessed May 10, 2022, <https://www.worldgbc.org/embodied-carbon>.

³ “Energy Efficiency in Buildings Facts and Trends: Business Realities and Opportunities (Summary),” World Business Council for Sustainable Development (WBCSD), accessed May 10, 2022, <https://www.wbcsd.org/gcltq>.

more stem from beliefs that sustainable materials cost more to grow and manufacture.⁴ Additionally it was observed that most people underestimate the greenhouse emissions put out by buildings. The results from this survey suggest that the perceived cost of incorporating sustainable design in construction is a major factor to why it is not as prevalent. However, sustainable design is not as expensive as people perceive it to be.³ The idea that sustainable design is more expensive than conventional building practices today, which mainly utilize steel and concrete, is a myth.

What Is Sustainable Design?

In order to compare conventional building practices with sustainable design it is important to define what it means for a building to be considered sustainable. There are standards in place that can objectively measure the sustainability of a building like the LEED certification and Passive House standards. LEED is a green building certification program and the “globally recognized standard for the design, construction and operation of high performance green buildings and neighborhoods.”⁵ The Passive House standard is a strategy to make buildings more energy efficient, minimizing the need for mechanical equipment like air conditioning and heaters by carefully considering shading, lighting, insulation and ventilation techniques. While the energy performance of a building is an important aspect of sustainable design, building materials also contribute to the sustainability of a building. Concrete has a large footprint because of the carbon emitting process used to make it. According to Building Green, production of Portland

⁴ Levke Maria Kehl, “The Myth of Increased Costs in Sustainable Building,” construction21.org, May 4, 2021, <https://www.construction21.org/deutschland/articles/h/the-myth-of-increased-costs-in-sustainable-building.html>.

⁵ “Green Building 101: What Is LEED?,” U.S. Green Building Council, accessed May 16, 2022, <https://www.usgbc.org/articles/green-building-101-what-leed>.

cement is responsible for 5% of total global carbon emissions.⁶ Finding alternative building materials with less embodied carbon is an important aspect of sustainable design. However, increasing energy efficiency and choice of building materials are important aspects of sustainable design that are often disregarded because they are thought to increase the costs of construction.

Zero Carbon Cultural Center Case Study

There are several examples of affordable and sustainable architect techniques that refute the idea that all sustainable design is more expensive than conventional building techniques. This



Figure 2: Zero Carbon Cultural Center built by Yasmin Lari in 2017. *Zero Carbon Cultural Center*, n.d., photograph, *Dezeen*, n.d., <https://www.dezeen.com/2021/11/05/zero-carbon-cultural-centre-prefabricated-bamboo-makli/>.

is evident as Pakistani architect Yasmeen Lari states that “a return to traditional materials and construction techniques could help eliminate carbon emissions.”⁷ Lari has “built more than 45,000 homes from mud, lime and bamboo,” and utilized these materials and techniques when

⁶ Brent Ehrlich, “Reducing Environmental Impacts of Cement and Concrete,” BuildingGreen (BuildingGreen, February 11, 2019), <https://www.buildinggreen.com/feature/reducing-environmental-impacts-cement-and-concrete>.

⁷ Jennifer Hahn, “Using ‘Ancient Wisdoms and Techniques’ Can Lead to Carbon-Neutral Buildings Says Yasmeen Lari,” Dezeen, July 2, 2021, <https://www.dezeen.com/2021/07/01/carbon-neutral-architecture-yasmeen-lari-interview/>.

building the Zero Carbon Cultural Center.⁷ The Zero Carbon Cultural Center was built to function as a community center for people in Southern Pakistan living in poor and marginalized communities. It was designed to host workshops for the community to strengthen their skills and improve the quality of life in the area. It is the biggest bamboo structure in Pakistan and one of the biggest in the world.

When designing the building, Lari took affordability in consideration as well as impact on the environment. To do this, she substituted “expensive, emission intensive materials such as concrete and steel, which would have to be transported to the site, with local materials that are low carbon, low cost, and have been used in construction for thousands of years.”⁷ Bamboo was chosen because it is both renewable and highly durable.⁸ It also allowed Lari to work with local artisans, and local people who wanted to learn how to build with it. As Lari helped educate members of the community on how to build out of bamboo, they were able to construct low cost homes for themselves. This was a part of Lari’s effort to create barefoot microenterprises which had the goal of empowering people to make “low cost, zero carbon, zero waste” architecture.⁹ While this was implemented in a small community in Pakistan, Lari believes that this model can be replicated worldwide. If individuals are educated on the importance of sustainable architecture and also its affordability, there is potential for the sustainable design movement to grow and become the norm. The use of bamboo in this form of green building disproves the idea that sustainable materials are more costly to grow, as bamboo is a fast growing plant that is affordable and easily accessible.

⁸ Lizzie Crook, “Prefabricated Bamboo Community Centre in Pakistan Built by Local People,” Dezeen, February 3, 2022, <https://www.dezeen.com/2021/11/05/zero-carbon-cultural-centre-prefabricated-bamboo-makli/>.

⁹ Shanaz Ramzi, “Retrospective: Yasmeen Lari,” Architectural Review, July 26, 2020, <https://www.architectural-review.com/buildings/retrospective-yasmeen-lari>.

Cal-Earth Case Study

Another example of contemporary use of traditional architecture techniques is Nader Khalili's nonprofit organization Cal-Earth. Cal-Earth utilizes a technique called SuperAdobe to build affordable homes around the world with the focus of addressing the global housing shortage. SuperAdobe is inspired by traditional earth architecture and is a form of earthbag architecture, which uses long sandbags, barbed wire and few tools.¹⁰ Khalili's design technique of using earth bags, like Lari's use of bamboo, goes against the common perception that sustainable materials are more expensive and harder to manufacture, as the earthbags are filled with easily accessible mud and materials that have very low cost. Cal-Earth home designs are energy efficient and use passive house techniques, with radiant floor slab heating and wind scoop passive cooling systems. Their conventional houses, called Earth One homes which comprise 3 bedrooms, 2 bathrooms and a 2 car garage, cost \$150,000 to build.¹¹ According to Forbes Magazine, the average cost to build a house in 2022 is about \$300,000, illustrating how Cal-Earth's sustainable architecture techniques are more affordable than conventional building practices.¹²

Additionally, the energy efficiency of Cal-Earth homes allow for the inhabitants to save money on energy bills in the long term. Not only do Cal-Earth homes have a lower upfront cost, they also continue to be financially sustainable with their increased energy efficiency. In examining their durability, Khalili says that the homes are “fire-proof, hurricane-proof,

¹⁰ “What Is Superadobe?,” CalEarth, accessed May 9, 2022, <https://www.calearth.org/intro-superadobe>.

¹¹ “Superadobe at CalEarth,” CalEarth, accessed May 9, 2022, <https://www.calearth.org/tour>.

¹² Rachel Abraham, “How Much Does It Cost to Build a House in 2022?,” Forbes (Forbes Magazine, May 2, 2022), <https://www.forbes.com/advisor/home-improvement/cost-to-build-a-house/>.

tornado-proof, and earthquake resistant.”¹³ Cal-Earth homes not only have a beneficial impact on the environment, but the nonprofit organization is also working to empower global citizens as



Figure 3: Junoot, Oman Collaboration with Cal-Earth. Awarded the World Architecture Award in 2021. Cal-Earth, *Junoot Eco Resort in Oman*, n.d., photograph, *Cal-Earth*, n.d., <https://www.calearth.org/alumni-projects2>.

they hold workshops educating individuals on how to construct these green buildings. While the Cal-Earth homes empower communities and have a positive impact on the environment, they are not viable for all locations. SuperAdobe houses are not realistic for metropolitan areas like New York City, but other sustainable design practices can fit that geographic context.

¹³ “Home Sweet Dome: How You Can Build Your Own House for a Fraction of the Normal Cost,” CBS News (CBS Interactive, May 12, 2014), <https://www.cbsnews.com/losangeles/news/home-sweet-dome-how-you-can-build-your-own-house-for-a-fraction-of-the-normal-cost/>.

Bullitt Center Case Study



Figure 4: Bullitt Center, designed by Miller Hull Partnership in 2012. Nic Lehoux, *Bullitt Center*, n.d., photograph, *Whole Building Design Guide*, n.d., <https://www.wbdg.org/additional-resources/case-studies/bullitt-center>.

Looking at examples of urban sustainable design, the Bullitt Center, designed by Miller Hull Partnership, distinguishes itself as the “World’s Greenest Commercial Building.”¹⁴ Located in Seattle, the Bullitt Center is a LEED Platinum certified six story office building. In order to make the Bullitt Center more sustainable, the developer limited the use of concrete to the bottom of the building. Above the foundation, “the Bullitt Center is constructed with heavy timber framing, recalling Seattle’s history of heavy timber warehouses.”¹⁵ All of the wood used is Forest Stewardship Council certified, which guarantees that it comes from responsibly managed forests.¹⁵ The Bullitt Center serves as an example on how contemporary architecture can still be made sustainable. Concrete was still used, but in limited quantities, and other design

¹⁴ Barbara Porada, “The ‘World’s Greenest Commercial’ Building Opens in Seattle Today,” ArchDaily (ArchDaily, April 22, 2013), <https://www.archdaily.com/363007/the-world-s-greenest-commercial-building-opens-in-seattle-today>.

¹⁵ WA DEI Creative in Seattle, “Building Features,” Bullitt Center Structural Materials Comments, accessed May 9, 2022, <https://bullittcenter.org/building/building-features/tall-timbers/>.

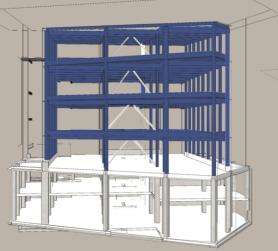
STRUCTURAL MATERIALS

All structural materials used in the Bullitt Center are locally sourced, from within 300 miles for steel and concrete and 600 miles for wood

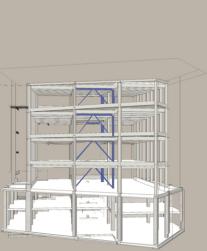
CONCRETE BASE



BUILDING CENTERPIECE: WOOD STRUCTURE



STEEL REINFORCING



Concrete base accommodates overall structure's substantial load and keeps earth away from underground levels

Heavy timber structure above 3rd floor is Forest Stewardship Council certified. Wood from responsibly managed forests has lower carbon footprint, aligns with historic regional traditions, and adds to aesthetic appeal

Steel connectors provide seismic and fire safety reinforcement, holding wooden beams together

**BULLITT
CENTER**
www.bullittcenter.org

Infographics Provided By:
INTEGRATED DESIGN LAB
UNIVERSITY OF WASHINGTON | 
www.idlseattle.com

Figure 5: Bullitt Center structural material breakdown. *Bullitt Center*, n.d., <https://bullittcenter.org/building/building-features/tall-timbers/>.

considerations were made to compensate for the carbon footprint of the steel and concrete.

One of the many notable sustainable design implementations in the Bullitt Center is its rainwater collection system. The Bullitt Center is able to supply its own water for tenants through a 56,000 gallon cistern, and this technology is particularly effective in a place like Seattle which is known for its long rainy season.¹⁶ The building also has a rooftop array of photovoltaic panels, which produce an estimated amount of 230,000 kilowatt hours a year, and in 2014, the Bullitt Center generated 60% more energy than it used, due largely to efficiencies that exceeded expectations.¹⁷ These efficiencies in the building refer to its effective placement of

¹⁶ Bryn Nelson, "A Building Not Just Green, but Practically Self-Sustaining," The New York Times (The New York Times, April 2, 2013), <https://www.nytimes.com/2013/04/03/realestate/commercial/the-bullitt-center-in-seattle-goes-well-beyond-green.html>.

¹⁷ Bullitt Center, "BULLITT CENTER FINANCIAL CASE STUDY," Bullitt Center, accessed May 9, 2022, <https://bullittcenter.org/2015/04/02/bullitt-center-financial-case-study/#:~:text=Across%20hundreds%20of%20tours%20with,Bullitt%20Center%20were%20%2432.5%20million.>

windows to sufficiently light the interior with natural light, as well as strategic use of shading and ventilation to minimize the use of mechanical heating and cooling. In the Bullitt Center's financial report it was stated that the total project cost \$32.5 million.¹⁷ As the first of its kind, the building cost more than conventional construction, but the project team noted that they are now confident that subsequent buildings will cost significantly less. Additionally, it is important to note that as the Bullitt Center is able to provide its own energy with its onsite renewables, they expect significant savings in long term utility costs.

Case Study Analysis

The case studies outlined above illustrate both traditional and modern techniques of sustainable design. While modern sustainable design utilizes new technology that is often more expensive than conventional building practices, the cost trend of these materials is going down. This idea was reflected in the Bullitt Center team's comment that subsequent buildings like the Bullitt Center will cost significantly less. In a report done by The World Green Building Council illustrating the Business Case for building sustainably it was found that building green does not necessarily need to cost more, especially "when cost strategies, program management and environmental strategies are integrated into the development process right from the start."¹⁸ In the examples of the Zero Carbon Cultural Center and Cal-Earth homes, affordability was a main part of the mission in the buildings' development, which allowed their designs to be low in cost. In comparison, the Bullitt Center focused more on achieving LEED Platinum certifications and maximizing sustainability in an urban environment, leading it to be more costly. While there can be additional costs associated with building green as compared to conventional building, "the cost premium is typically not as high as is perceived by the development industry."¹⁸

¹⁸ World Green Building Council, "PDF," n.d.

Awareness of the importance of sustainable design is important for green buildings to become a norm. As investors and occupants become more knowledgeable about and concerned with the environmental and social impacts of the built environment, buildings with better sustainability credentials will be in higher demand. Looking at the examples of the Zero Carbon Cultural Center and Cal-Earth, the integration of community education in their development helped increase the number of sustainable structures in the area. Furthermore, “studies around the world show a pattern of green buildings being able to more easily attract tenants and to command higher rents and sale prices.”¹⁹ In a study done by UC Berkeley, 694 green buildings were compared with 7,489 other office buildings, each located within a quarter mile of a green building in the sample. It was observed that on average, certified green office buildings rented for 2% more than comparable nearby buildings, and had significantly higher market value.²⁰

When examining the cost of the Bullitt Center and its acquisition of the LEED Platinum certification it is important to acknowledge a study done by the construction firm Davis Langdon which found “no significant difference between the average cost of a LEED certified building and other new construction in the same category.”²¹ Essentially, there are expensive green buildings, but there are expensive conventional buildings as well. “Certification as a green building was not a significant indicator of construction cost,” it is just perceived to be that way.²¹ To statistically back this point, the US Green Building Council has also performed numerous studies and concluded that the cost of reaching LEED certification is between zero and 3% more

¹⁹ World Green Building Council, “PDF,” n.d.

²⁰ Tamar Saunders, “Climate Change and the Built Environment – Is Enough Being Done? the Case for Concrete Alternatives,” Master of Development Practice, accessed May 9, 2022, <https://mdp.berkeley.edu/climate-change-and-the-built-environment-is-enough-being-done-the-case-for-concrete-alternatives/>.

²¹ Nora Knox, “Green Building Costs and Savings,” U.S. Green Building Council, accessed May 9, 2022, <https://www.usgbc.org/articles/green-building-costs-and-savings>.

and the cost of obtaining the highest LEED certification (platinum) comes at a cost premium of less than 10%.²² These percentages come from a study of 40 US offices and schools that “found cost premiums substantially lower than professional estimates revealed in their respective project research.”²² The Bullitt Center also exemplifies how while a green building may have higher upfront costs, their long term utility costs will be less because of their improved energy efficiency. According to the Green Building Council, “green buildings have shown to save money through reduced energy and water use and lower long term operations and maintenance costs,” and “energy savings in green buildings typically exceed any design and construction cost premiums within a reasonable payback period.”²³ This disproves the idea that sustainable buildings are more expensive further as in a long term period, sustainable buildings have the potential to actually be more affordable than conventional buildings.

Conclusion

Sustainable design does not mean new technology and expensive material. So many things constitute sustainable design which are often up to debate. Changing practices like wearing more or less depending on the season, refurbishing a building instead of completely tearing it down, and utilizing traditional building practices are all aspects of sustainable design. The common perception of green buildings being new, modern developments disregards the diversity of sustainable design. In order to make sustainable design ubiquitous, more needs to be done to educate the community about consequences of climate change, and how new constructions significantly contribute to the carbon emissions in the atmosphere. Governments should also create more policies that encourage green building, and this can be done through subsidies and building regulation. It is not enough to just wait around for the demand of

²² World Business Council for Sustainable Development, “Energy Efficiency in Buildings,” n.d.

²³ World Green Building Council, “PDF,” n.d.

sustainable buildings to increase, intervention is crucial and urgent. It is common for society to look for instant gratification, and that is reflected in developers seeking the lowest upfront construction costs, but in reality a lot more benefits could be reaped long term if sustainable design strategies are integrated.

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