

A Case Study in the Improvement of Construction Efficiency via the Analysis of Contemporary Sustainable Practices

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Abstract:

Construction firms can sometimes reflect a lack emphasis over environmental concerns in the design and implementation of building projects. This does not have to be the case however. The following report details some current sustainable construction materials, technique, design, and building practices. It then discusses the implementation of such practices on an individual case basis. The site chosen was Hanover Page Mill, a cutting-edge LEED platinum green built office suite in Palo Alto. Research into sustainable practices was then applied to the building and combined with direct consultation and visual inspection to analyze the effectiveness of the project design and methodology. Follow up work will be required to determine the break-even point, longevity, and amortization of the sustainable build out and analyze actual profitability from the green construction at Hanover Page Mill.

Key Words: Sustainable Construction, Environmentally Sound Practices, Ethical Material Sourcing, Energy Neutral, Green Construction, Menlo Park, LEED Platinum Certification

Introduction

It is plausible if not intuitive that often the most successful companies are not those that produce the highest gross profit but rather those who can control costs and maximize supply side efficiency. This does not pertain to construction alone but rather business practices in general. Successful companies tend to reduce the cost of production to maximize net profits. In construction, this practice is often an essential feature of building a profit margin. If a bid is accepted at a certain rate and is performed for under that rate, a representative market correction has occurred that provides more information about the market to its participants and profit for the firm. Therefore, any individual who seeks to succeed in construction management must possess an essential understanding of cost reduction. The costs involved are not always just financial however. They can often be physical. Environmental costs are particularly pertinent to construction because of the potential for long lasting and far reaching consequences that poor construction habits can create. Environmental damage that is deemed the responsibility of the firm can incur lasting expenses to which a company may be liable for mitigation long after the harm has been done. The best way to eliminate these risks is to build in a manner that addresses long term environmental issues. After all, a building must reside in the nature that surrounds it for its entire life.

Often in practice the simplest solution to this problem is conscious collaboration regarding the environmental concerns relevant to the job site and the business plan. There are many techniques that can allow for the optimization building inputs toward this end with environmental benefits in mind. The focus of this report is to evaluate the effectiveness of current sustainable practices in conventional construction methods via analysis of an individual case study on an environmental impact basis. By using state of the art cultural practices, knowledgeable consulting, and cutting edge engineering, the project team could maximize utility while minimizing the environmental impact and build out costs.

The benefits of sustainable practices have become sought out more often in recent times as the effects of our environmental impact is becoming better understood globally. Construction is not immune from these shifts in attitude, and seeks to maximize efficiency by improving sustainability. Although it is a very common buzz word, sustainability is not as universally understood a concept as it should be.

General Background:

Sustainability

Sustainable construction can be defined as “the adoption of materials and products in buildings and construction that will require less use of natural resources and increase the reusability of such materials and products for the same or similar purpose, thereby reducing waste” (Mehta 2013) These practices often imply that rational thought and forward thinking has gone into the design as well, which is usually all that a client would ask from a dependable builder. Sustainable practices are not only a benefit to the participants in the business transaction but to the public as well, as construction moves toward a future with the minimum possible amount of environmental damage possible while still participating in industry.

Benefits of Sustainable Practices

Sustainable construction, it may be argued, begins with reasoned material considerations and ethical sourcing. Often the bane of a larger industrial firm is their willingness to accept the most profitable bottom line as a sole determinate of the business plan. Historically, less ethical firms have left the environment a secondary consideration, assuming the earth cannot be ‘managed...[since] the management of nature entails its capitalization, its treatment as a commodity...’ (Escobar 1996) More optimistic minds have posited, and often demonstrated, that environmentally sound production practices and decisions can be mutually beneficial to the firm, the client, and the surrounding nature.

Ethically Sourced Materials

Due to improvements in proprietary manufacturing, sustainable materials have become easier to source. Ethically sourced materials can be as simple as demanding ecologically responsibly sourced lumber to mitigate deforestation, utilizing recycled plastics and fiber materials, understanding the environmental pressures the project may cause, and installing site based considerations such as skylights and solar panels to reduce power consumption or become electronically neutral as the Page Mill Site is. The goal of such oversight is “to ensure that the project will represent comparable results to conventional contemporary practices while incurring similar if not equal costs along the way. Existing research shows that construction activity has a significant impact on the environment.” (United States Green Building Council)

The Role of Individual Firms

Individual firms play an important role in promoting sustainable development within the context of the construction industry by assuming the responsibility to minimize their negative impact on environment and society and maximize their economic contribution. The result is a building that encompasses a proof of concept that environmental stewardship can also accomplish competitive business goals. “The relationship between environmental and economic performance and social responsibility committed by firms has been studied by many researchers. The ‘traditionalist’ view of neoclassical environmental economics [which argues] that the environmental protection activities would reduce economic success. In contrast to this view, the ‘revisionist’ view... argues that the sustainable practice by a company has a beneficial effect on its economic success; and the purpose of environmental regulation is actually to correct for negative behavior which would consequently burden companies with additional costs.” (Ding 2007) The project team at Hanover Page Mill has sought to and achieved the goal of producing an exemplary sustainable construction process coming to fruition. They endeavored to set themselves apart from other firms in that they made a conscious decision to build sustainably and profit accordingly. The two are certainly not mutually exclusive, though it takes a complex and multifaceted plan to successfully break the status quo of contemporary construction practices, which as a default tend to require less oversight and planning.

LEED Platinum Certification:

LEED stands for Leadership in Energy and Environmental Design. It is a third-party ratings agency which functions on a point system based on the Energy liability created by a building. There are several levels of certification ranging from certified, to silver, to gold and finally to platinum; platinum being the lowest environmental impact and therefore the hardest to attain. LEED certification on every level accounts for a building's ability to use less electricity and water, utilize responsibly sourced, sustainable building materials, and reflect a level of environmental stewardship and protection. The guideline for certification levels is broken up under environmental prerequisites and building credits that a firm can pursue: "Prerequisites are the green building standards every project must meet. Credits allow project teams to customize how they pursue certification. By fulfilling credits, projects earn points that determine its certification level: Certified (40-49 points), Silver (50-59 points), Gold (60-79 points) and Platinum (80+)." (United States Green Building Council 2017) The Hanover Page Mill site is Platinum certified, meaning that the highest level of consideration possible went into these important green building attributes.

Interview with Jim Gaither Jr.

Jim Gaither, the owner and Developer of Hanover Page Mill, made time to provide primary source material for this report via phone interview. Gaither explained that changing market conditions are driving firms towards developing a competitive edge. For Devcon, this competitive edge is sometimes to build Green. Green buildings are extremely well received, aesthetically pleasing, and can bring a premium in leasing agreements. In general, Green buildings are more desirable, represent more of a constructive challenge, and allow people to feel as though their work place is contributing to their health rather than detracting from it. In this way, demand to secure space within Hanover Page Mill is higher, and should remain as such.

Objective

The aim of this report is to gain an understanding of current green building materials, methods, technology and cultural practices. This was accomplished by researching sustainable materials, assessing current proprietary practices, reviewing site plans and building layout, meeting with people from the team who helped to implement the design, and finally evaluating the 1400 Page Mill property for adherence to contemporary methodology and the intricacies of the design. In such a manner a thorough understanding of the current and future state of green building technology was developed via a multifaceted approach; much like the design and buildout of the project.

Methodology

Current Industry Standard

The basic steps to develop a sustainable building, studied and aggregated by far reaching academic assessment have been expressed most concisely as such: "the major components of the framework include project environmental assessment, environmental policy, organizational structure, environmental management program and external/internal audit of environmental performance." (Hill and Bowen 1994) In completing the case study each of these aspects was individually researched and then systematically applied to Hanover Page Mill.

Procedure

1. Research on sustainable materials was performed independently and collaboratively over common practices on other jobsites. An understanding of how these two compare on paper was then developed by discovering which of these contemporary proprietary considerations was implemented at 1400 Page Mill. This was accomplished by referencing news and journal publications, texts, and individual consultation.
2. Research on sustainable cultural practices on site was performed via phone interview with Jim Gaither Jr., the owner and developer.
3. The job site was visited in person to visualize the effect of sustainable infrastructure and technique in practice.
4. An Analysis of the implementation, efficiency, and effectiveness for the build out could then be produced that contrasts the build out of Hanover Page Mill to conventional construction practices.

Results and Discussion

Site Layout and Metrics



Figure 1. Photos of the completed Hanover Page Mill project providing an aerial view and a view of the façade.

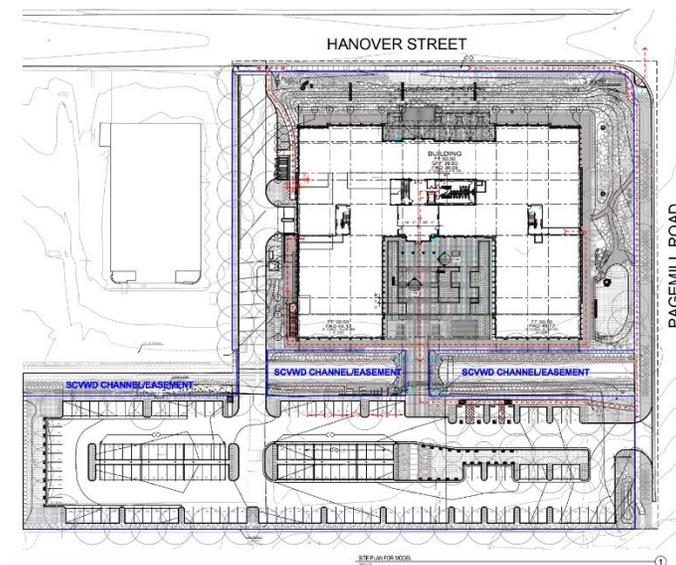


Figure 2. Schematic of the site plan and infrastructure layout

The Hannover Page Mill was designed using a more collaborative, comprehensive process. Unlike conventional designs, the architect utilized real time input from contractors, consultants, and other experts to troubleshoot the final product before implementation. This allows for a faster build out since fewer problems arise as minds meet and boards begin to erect. It also allows contractors to familiarize themselves with green building design techniques, and architects to understand green building cultural practices.

For the case study at hand, these green infrastructure installations consisted of, among numerous other individual examples of cutting edge sustainable infrastructure. Among others these include “High efficiency VAV HVAC systems, LED lighting with automatic daylight harvesting, a state of the art, thermally broken glazing system, continuous stone wool insulation...continuous spray foam insulation, and glass fiber reinforced walls... Each façade was fitted with sunshades ranging from 12 to 30 inches deep.” (Hanover Page Mill Associates 2017) It is clear then from these examples of electrical efficiency that the team involved has gone to extreme ends to ensure an attitude of environmental stewardship is perceived within their building practices. Ultimately, the idea is to improve public perception while decreasing liability. Thus, the conventional view that environmentally conscious construction is tedious and burdensome has given way to the alternative that in fact green building is not only aesthetically pleasing, ethically sound, and if accomplished correctly is, also the best decision for the business.

It is not only electricity savings where the team has produced a product that stands out; the Hanover Page Mill building “uses 40% less water for toilet flushing, hand washing, and showering over baseline via use of low-flow fixtures. Through drought-tolerant plantings and water-efficient irrigation systems, 55% less potable water is required for landscape irrigation. Additionally, the building is dual-plumbed to use recycled water for toilet flushing and irrigation, when it becomes available from the City of Palo Alto.” (Hanover Page Mill Associates, 2017) one of the most important aspect of such infrastructure is the distinction between building green for a tax break and building green due to integrity of principle: at present day when talk of “Green Energy” and “Green Building” are so prevalent and encouraged, the environment now makes it easy to think green, and build green. It is an entirely different operation, however, to build green in a manner that will still be relevant in ten years, or even five. This is what sets the Page Mill Road site apart from its contemporaries. It possesses both the LEED Certified Platinum design that distinguishes it from its peers in its prime, and the collaborative implementation that will maintain the office space as one of the more sought after locations to do business in the area for years to come.

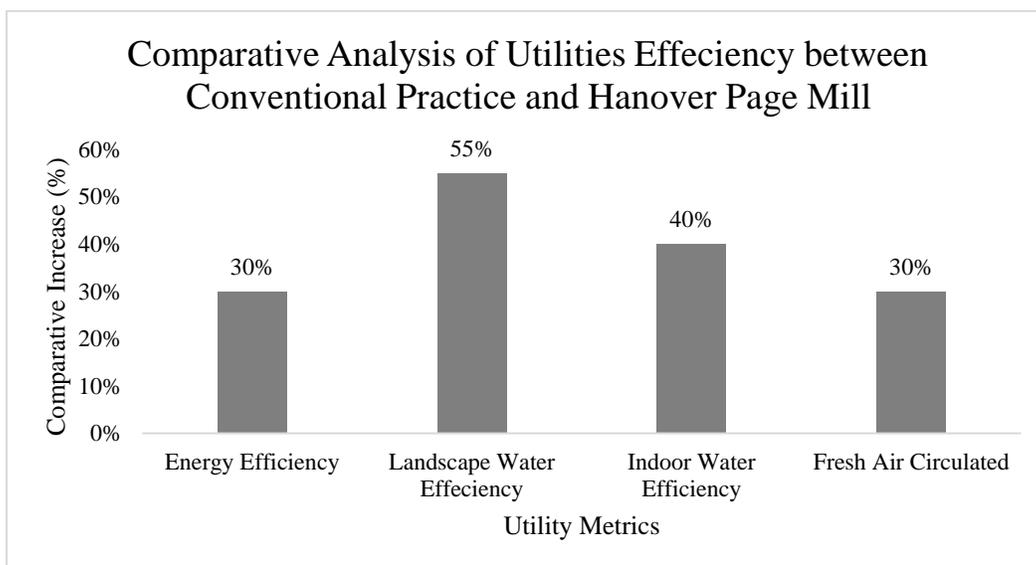


Figure 2. Comparative analysis of Hanover Page Mill green utilities metrics indoor water efficiency, fresh air volume, energy efficiency, and landscape water efficiency as contrasted to similar metrics for contemporary conventional practices. (Hanover Page Mill 2017)

The Page Mill Road project has culminated many individual system improvements to become as much as 50% more efficient in some aspects of their installation compared to conventional methods. The Page Mill project is more efficient in the amount of utilities used such as water and electricity. This stems from an understanding of sustainable practices that can maximize the best use of water and electricity on sight. Factors such as insulation and window material are often considerations left to price point that are vital to energy efficiency. The building is in fact so energy efficient that it achieves a net zero electric status (Hanover Page Mill Associates 2017), meaning that it produces as much electricity as it uses. This is made possible by the top of the line photovoltaic solar cells that line the roof and carports of the building. By securing the power necessary to operate the building on site, the project will hopefully remain relatively self-sufficient, even as the cutting-edge of sustainable infrastructure progresses beyond the status quo at the time of breaking ground. To this end, “Jim Gaither and Jim Gaither Jr. of Hanover Page Mill Associates wanted their new 87,000-square-foot commercial office building to have net zero electrical usage with 100% of the electrical load offset by on-site PV generation. The owners also wanted a beautiful PV system. The Gaithers contracted Sun Light & Power (SLP) as the design-build firm for the PV portion of the project. During the 2 years of design and construction, the design team reduced the PV system capacity from 633 kW to 412.16 kW as it refined the energy model and increased the energy efficiency of the planned building” The building could also potentially be retrofitted should solar panel technology or other such proprietary advancement be made that could extend its functionality.

These considerations extend to the environment globally as well, however. For example, out of the 100% of the electricity provided by solar panels, 15% is allotted for the charging of electric cars. This is meant to accomplish both long and short term goals: in the short term. It becomes very convenient to operate an electric vehicle when working at this office, since the car can be charged in a parking stall outside while the owner is being productive inside. However, this convenience also has the positive effect of encouraging others to wish to purchase an electric vehicle once they realize the cost savings of generating fuel for the drive home while you are at work. People will often do what is most convenient en masse, so it follows that if electric cars are the most convenient option, people will adopt them and be drawn to the building.

Future Research

A follow up case study to analyze the longevity and marketability of the sustainable features at Hanover Page Mill is necessary to confirm or reshape the projections in this report. While it has been established in literature that sustainable construction can be a profitable venture, a breakeven analysis within the individual case study could then be completed regarding the point in time after implementation at which sustainable construction practices begin to generate profit on site. A better understanding of the duration that sustainable materials and practices remain relevant as they age could be then be developed, providing market information about the cost-benefit breakdown of sustainable infrastructure. This building is ground-breaking. Nobody has done this, and they took a lot of risk to do it,” said John Marx, principal at Form4 Architecture, which designed the building. “They had to pay all of that money upfront, and the question is: Will they get it back? They said ‘yes.’” In this manner up-front costs, overhead, longevity, and the amortization of the materials and methods can be analyzed and a more accurate profit margin assessed.

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