How can the built environment improve on sustainability while serving practical needs?

Undergraduate Thesis Prospectus

A Proposed Design for the IDEA Factory, the University of Maryland's Planned STEM Building

(technical research project in Civil Engineering)

The Struggle to Promote Adaptive Reuse in U.S. Construction Projects

(sociotechnical research problem)

by

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

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General Research Problem: Actionable Progress toward Sustainability in the Built Environment

How can the built environment improve sustainability while serving practical needs?

According to a 2021 BBC article, roughly half of raw materials extracted from the Earth go into the built environment. The same article goes on to mention that a third of the worlds overall waste in generated by construction, not to mention it's carbon emissions (Miller). As a society facing a climate crisis, it is our collective responsibility to make observations such as those made in the article mentioned above and generate solutions that reduce waste, preserve resources, and continue to provide a practical but responsible built environment.

A Proposed Design for the IDEA Factory, the University of Maryland's New Construction STEM Building

What is the optimum design of a university building intended to promote STEM innovation?

For a capstone project my group will provide a response to a request for proposal (RFP) for a new construction project; the IDEA Factory STEM building on the University of Maryland campus. The RFP will include design aspects and construction recommendations based on site conditions and economic factors.

The RFP response is a civil engineering department capstone project. The industry partner for this project is Clark Construction, a prominent general contractor in the D.C., Maryland, and Virginia (DMV) region. The UVA faculty advisor for the project is Professor Diana Duran, and the student-team is made up of six fourth-year civil engineering students: Logan Holsapple, Mike Rogerson, Faythe Way, Zubaidah Al Jumaili, Tony Tran, and myself.

Project goals include providing ground water management design, foundation design recommendations, and designing a site logistics plan for the duration of the project. The project will also consist of a structural system recommendation and a schedule optimization plan.

A challenging aspect of the project will be the request to include a basement in the construction of the IDEA Factory. The area where the project is located has a high-water table, so accommodating this request will require careful research and planning. Another element of consideration in the construction of this building will laboratories that can tolerate only minimal amounts of movement by the structure to operate effectively. Some examples of existing buildings designs that carefully manage vibration for labs and sensitive equipment include the Centre for Nanoscience and Quantum information at the University of Bristol (2024), and the Louis A. Simpson and Kimberly K. Querrey Biomedical Research Center at Northwestern University (Graham, 2024). These buildings both have carefully designed structural systems to minimize the effects of vibrations generated by normal building use, from running the HVAC system to vibration caused by footfalls.

Methods for reaching project goals include meeting with our industry partner to get professional advice and input in areas such as cost estimation and scheduling, refining designs, and compiling the information into a presentable document for official submission. Much research into foundation systems, site logistics design, and site drainage techniques will be critical to producing a professional response and creating a winning RFP.

The successful completion of this project will take the form of both an official document and a presentation. The document will contain explanations of recommendations, the proposed project schedule and budget, and detailed design information. The presentation will be a formal presentation version of the RFP document. At the completion of this project our team will have

developed skills necessary to collaborate as a team, communicate research to a potential client, and we will have a better understanding of how the civil systems we studied for that past three years come to fruition in the form of a response to an RFP. The next step in the completion of this project would be to await a response from the potential client to see if the project is awarded to our group or to take account of why the project was lost and to incorporate lessons learned into the next RFP response.

The Struggle to Promote Adaptive Reuse in US Construction Projects

In the US, how are environmental advocacies, investors, and local governments striving to promote adaptive reuse?

While some say the greenest construction is none at all, the next best thing may be the practice of adaptive reuse. Adaptive reuse is a responsible climate solution that preserves and improves neglected structures by retrofitting and reimagining an altogether new purpose for them. Through adaptive reuse the character and rich history of communities can be protected and, in some cases, brought back to life. For this reason, I propose that it is worthwhile to explore the mechanisms at work that allow adaptive reuse projects to come to fruition.

Implementing adaptive reuse involves many parties, some of which include local governments who support or discourage the practice in their jurisdictions (City of Detroit, 2024; Lee, 2023) and organizations such as the World Green Building Council (WGBC) who establish standards for green construction practices (WGBC, 2023). Other participant groups include citizen organizations such as the Central City Council of Los Angeles who unite behind values such as green building practices and affordable housing for all. Lastly, investors and builders

evaluate the practicality of adaptive reuse for specific areas and structures (Garcia & Kwon, 2021).

Taking advantage of existing abandoned structures like warehouses and old airplane hangars to imagine a new purpose for these buildings inherently reduces waste because part of the project is already standing. This means less steel, glass, and other materials are needed than would be for a new construction project. What that amounts to is not only less waste in our landfills, but an energy saving practice as well. Merlino (2014) writes that viewing buildings as repositories of energy and materials, "repositions the way we value of the built environment for a more sustainable future."

A common theme repeated throughout the literature on adaptive reuse is that of the human connection to place and history through the built environment. Here emerges yet another form of value taking shape; the cultural and historical value of a place. Robiglio (2016) proposes that reuse is good for local culture because it reflects the history of the city while serving a new, modern purpose. Robiglio also points out that existing form finds roots in a city's identity, and he asserts that "reuse strengthens a community feel by positively linking a city's past to its future". This connection to place can work in favor of adaptive reuse when it comes to a question of either, or: new construction or adaptively reuse the existing structure? For example, in examining cost-benefits for either a new construction building or an adaptive reuse project in San Francisco, a design and development team was encouraged by neighbors to pursue adaptive reuse project over new construction. Although the neighborhood support was based on reduced parking and traffic demand, the support of neighbors cannot be undervalued (Garcia & Kwon, 2021).

Just as neighborhood support can play a role in the success or demise of any construction project, local building codes and laws can help or hinder adaptive reuse. In cities like Los Angeles local governments have taken action, passing laws that in many ways incentivize adaptive reuse. For example, in 1999 in an effort to expedite approval processes for adaptive reuse projects and to ensure that historic buildings converted into housing were not subject to the same scrutiny as new construction, Los Angeles adopted a specific adaptive reuse ordinance (Rosenberg, 2012). The ordinance today includes an exception from having to provide additional parking for a project, building codes specific to adaptive reuse projects, and the ability to make changes to a project without triggering the California Environmental Quality Act (CEQA). On the other hand, "The California Existing Building Code (CEBC) has strict compliance requirements which can serve as a barrier to conversion and offers limited flexibility for architects and engineers" (Garcia & Kwon, 2021). The Terner Center Report goes on to suggest that training for building inspections of adaptive reuse projects specifically, and flexibility in the CEBC would help lessen risk and provide support for future adaptive reuse projects.

To provide standards and accountability in the construction of sustainable buildings the United States Green Building Council (USGBC) was formed. Out of the USGBC, the Leadership in Energy and Environmental Design (LEED) rating systems are established with the goal of reducing negative impacts of buildings on the environment and human health (Chudasama, 2023). However, with a large focus on efficient energy use and using interior finish materials that reduce negative impacts on human health, many believe the standards set by USGBC and LEED fall far short of the climate action needed to make significant progress toward a truly sustainable future. Boschman and Gabriel (2013) write that some LEED requirements discourage adoption of the program due to significantly higher construction and documentation costs,

onerous documentation procedures, and a complex self-reporting system, among other things. There is also concern that LEED does not adequately consider the lifecycle analysis of green buildings. Instead, Boschmann and Gabriel propose a return to the implementation of vernacular architecture, or the architectural style whose design is based on local needs and geography. In support of adaptive reuse, Boschmann and Gabriel highlight the practical designs of the past which incorporate local climate and materials into design without the need for mechanical or electrical systems to create comfortable interior environments.

Lastly, it is important to point out that progress toward a sustainable future is not just an issue of securing a better, healthier world for generations to come, but it is also a form of activism. In a powerful report out of the Lincoln Institute of Land Policy, Schilling and Velasco write, “Urban sustainability is valuable in its own right as a means of reversing the damage inflicted on all communities through decades of environmental neglect, ruthless winner-take-all economics, and deeply ingrained, structural socioeconomic and racial inequities”. Adaptive reuse is a practical form implementing green building practices into the construction industry and as discussed there are communities of support to see the practice grow and succeed. There is however still much work to do to improve and promote this growing practice as a tool driving us toward sustainability and equity in the built environment.

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