A Systems Approach to Examining Adaptive Reuse as a Sustainable Construction Practice in the U.S.

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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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Introduction

According to a 2021 BBC article, roughly half of raw materials extracted from the Earth are used to construct the built environment, and a third of the worlds overall waste is generated by construction (Miller). While some say the greenest construction is none at all, the next best thing may be the practice of adaptive reuse (Robiglio, 2016, p. 5). 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. And of course, there are the investors and builders who evaluate the feasibility of adaptive reuse in specific areas (Garcia & Kwon, 2021). As a guiding framework, systems theory is used to examine the interconnections of climate progress, social issues, government intervention, and economy. Jianguo Liu et al. (2015) describe systems theory or systems integration to be a holistic approach to "integrating various components of coupled human and natural systems (for example, social-ecological systems and human-environment systems) across all dimensions." Systems theory is particularly useful in framing sustainable designs as it takes into account the complexity of systems that interact with one another. As a society facing an imminent climate crisis it is our collective responsibility to make observations about the destruction of the natural world and generate solutions that reduce waste, preserve resources, and continue to provide a practical but responsible built environment.

To understand the quantitative value of adaptive reuse, this paper begins by familiarizing the reader with embodied carbon and the far-reaching consequences of manufacturing raw materials. Next, real-world examples of adaptive reuse and quantitative energy savings and greenhouse gas

emissions are discussed. To understand the social aspects of adaptive reuse discussion turns to the connection communities have with the build environment through history and lived experience. Next, taking sustainable choices can be an act of social justice and this is examined in the next section of this paper. Finally, an example of community opposition to adaptive reuse is provided, followed by an examination of green building incentive programs.

Embodied Carbon & Global Impacts of the Built Environment

Using materials that are already standing or that already exist in a building is the equivalent of recycling water bottles or aluminum cans and is the environmentally responsible thing to do. Boschmann and Gabriel define embodied carbon as "the estimated sum total energy cost of a building from cradle to grave." This quantity includes the energy used to process raw materials into a usable product (manufacturing), the transportation of the material to the location where it will be used, the energy consumed in the construction of a project, the energy consumed in operations and maintenance of the end product, and finally, the energy consumed in demolition (2013, p. 224). In considering only a single building the embodied carbon might not be so perplexing to imagine, especially if materials are sourced locally to a project's location. On a larger scale however, the embodied carbon of all new construction projects in North America alone have significant energy implications.

To further understand the global impact of the built environment, it's important to recognize how cities affect areas far beyond their own national borders. Professor Herbert Girardet elaborates on the impact of cities on the natural environment in his article, *The Metabolism of Cities* (2023). First, Girardet points out, "there is little serious discussion about the linkages between cities and their distant 'sacrifice zones'" (p. 2). The sacrifice zones Girardet refers to include deforestation of the Amazon, mountain top removal to mine coal in Appalachia, acidification of our oceans, and the formation of dust bowls, just to name a few. These zones can be linked to cities and the built environment in quantifying the growing demand for energy consumed by cities which grows as more construction takes place, which requires coal for power and mountain top removal takes place as a result without regard to the effects on the local population of Appalachia, and so on as it applies to consumption of other goods, and resources. One way to interpret Girardet is to

think, there must be a better way. Or from a builder's perspective, how can embodied carbon and widespread reach of environmental harm linked to the built environment be reduced? One way to do so is to capitalize on the materials already existing.

Contextualizing Adaptive Reuse

By reducing the need for raw material extraction and processing, builders can make meaningful progress toward sustainability. Adaptive reuse is the practice of renovating an existing structure to serve a new purpose, in essence recycling an old building into a new and slightly different one. One example of adaptive reuse is the Highline public park in New York City. The Highline was a community organized effort to turn an old metro track into green space (Robiglio, 2016, p. 8). The Coal Drops Yard in King's Cross London is another exceptional example of adaptive reuse where semi-abandoned coal storage spaces, first built in the 1850's, were turned into commercial and restaurant space around 2018 (ArchEyes, 2024). In these projects, using the materials existing at the site stretched the life of the material into the future thereby reducing embodied carbon and mitigating negative environmental impacts that would have resulted from raw material extraction and processing. The preserved materials include concrete and steel, which are known for high carbon emissions in their production.

For a look at real-world examples of embodied carbon Katharine Logan, an award-winning writer for her work in design, sustainability and well-being in the built environment, provides three excellent examples. First, in preserving two-thirds of a 45-story tower in Sydney and building it out to 50 stories, 8,250 tons of green-house gas emissions were saved compared with building a completely new structure. In Los Angeles, a seismically damaged lab space that was originally scheduled for demolition was redesigned to serve the needs of university administration and students and achieved an 82% reduction in embodied carbon. Lastly, in Denver, "a failing 1960's telecom building" was adapted for mixed-used workspace and achieved a 68% reduction of embodied carbon. These quantities provide evidence that existing materials in the built environment can remain a part of the built environment and serve an altogether new purpose. Apart from continuing to be part of an existing structure, the reused materials preserve natural environments and improve air quality by reducing the need to extract

new materials and reducing carbon and other emissions in the process. These are just two examples, but from a systems point of view, the positive impact adaptive reuse can have on our environment, on a large scale, is far reaching.

Connection to Place and History

Adaptive reuse is valuable for its contributions to sustainability, but by restoring buildings that have been trademarks of a community, builders and architects pay homage to the local history and urban character. Boshmann and Garcia write, "Not only are buildings a space where everyday life activities occur…They are filled with cultural symbolism, their architecture can tell stories of local history, and they can help create a sense of place" (2023, p. 222). In this way, adaptive reuse respects the connection people develop to a place which often includes elements, if not larger swathes, of the built environment. Robiglio, grantee of the German Marshall Fund of the United States, proposes that reuse is good for local culture because it reflects the history of the city while serving a new, modern purpose (2016, p. 5). That is to say, human connection to the built environment manifests in culture and identity not just in a city itself but in its residents and those who interact with the built environment every day. In their work to sustainably revitalize cities that once served as industrial centers and currently face population loss and economic decline, Schilling and Velasco acknowledge that "great urban form…creates a strong sense of place" (2020, p. 20). In other words, adaptive reuse allows local history and culture to be preserved and respected not unlike a passed-down, family heirloom linking the present to a rich and cherished past.

On the other hand, Robiglio (2016, p. 13) points out that not every old building is fit to meet the requirements of a re-envisioned purpose. It is important to examine structural competence, and in some cases the structure simply does not meet strength requirements. In this case, the cost to rehabilitate the structure may outweigh the benefits of reuse. Additionally, as in many legacy cities, a site might need extensive environmental remediation before construction can take place. Since costs often determine the feasibility of projects, the amount of remediation required may result in abandonment of the project. That being said, it is important not to discount the potential of a building's future purpose. The re-imagining of vacant lots in the suburbs of Detroit to

community gardens is a testament that the possibilities of adaptive reuse are limited only by our ability to imagine what could be and the initiative to take up the challenge. Again, in the toolkit for adaptive reuse Robiglio remarks, “The issue these places are facing is the loss and lack of uses and activities, so there is no need to be exclusive.” (2016, p. 17)

Sustainability as Activism/Social Justice

Progress toward a sustainable future is not just an matter of securing a better, healthier world for generations to come, but it is also a form of activism. In The Death and Life of Great American Cities, journalist turned activist, Jane Jacobs writes about four conditions that drive successful neighborhoods. One of those conditions is the inclusion of aged structures. (The four magic ingredients, 2020). In the 1930’s and d1940’s, aged structures were often considered blight, a term infused with racial and class bias. Today on the other hand, aged structures are preserved in many forms of adaptive reuse and they are cherished as monuments of the neighborhoods they occupy. These aged structure contribute to the character of a neighborhood and provide space for welcome community interactions to take place. Jacobs became an activist after publishing her first criticism of a superhighway project in 1958. Her community was threatened by construction of a superhighway that would have changed Manhattan from what we know it to be today. Her advocacy challenged dominant planning doctrine at the time; that cities needed to be reconstructed for cars. Inspired by Jacobs and in the face of destruction of the natural world to an irreversible point, I take up the mantle and challenge another form of dominant thinking around the built environment; that new is better and old is out. More specifically, this country has rich communities worth investing in and one way to support those communities and take action against climate change is to pursue adaptive reuse projects, especially in areas experiencing neglect.

To take the idea of sustainability as a form of activism further, Schilling and Velasco (2020, p. 13) write that, “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 form of urban sustainability that transforms existing structures that were

previously unused into reinvigorated used space. Potential new uses could include space for small business, or community and shared public space such as libraries or community centers. These uses promote social cohesion and environmental justice by prioritizing building up communities instead of exploiting them for economic gain, an idea very much against the grain of an exploitative capitalist economy.

Community Opposition and Green Building Incentive Programs

Not in my back yard, or NIMBY as it's commonly known, is an example of community resistance to resource sharing and similar efforts to deconstruct segregation in its modern form. NIMBYism can present significant challenges to equal access projects and a variety of other projects. However, according to the Terner Center for Housing Innovation at UC Berkeley, communities are more likely to support retrofit projects (adaptive reuse by another name) over new construction. For example, Garcia & Kwon write that in pursuing a supportive housing development known as Cordell Place, "the developer and nonprofit partner were able to avoid opposition from neighbors" because the housing development was pursued in the form of converting an abandoned office building into affordable housing. Furthermore, in a proposal to build a *new,* similar supportive housing structure just six blocks from Cordell, the local community fought in opposition for six years, resulting in delays and cost escalation for the project (Garcia & Kwon, 2021, p. 6). From the perspective of developers or even community leaders in search of housing solutions or economic revitalization projects, adaptive reuse can prove to be an option that incurs less risk when it comes to facing resistance by the surrounding community.

Other incentives for promoting adaptive reuse take the form of legislation at the local, state, and even federal levels. Similar to tax incentives for the purchase of an electric vehicle, financial and bureaucratic levers can be used to promote adaptive reuse projects. In the case of the notoriously congested city of Los Angeles, city council passed an "Adaptive Reuse Ordinance" to specifically address a housing shortage. The ordinance ultimately worked not only to address the housing shortage, but it also helped promote walkable neighborhoods. By facilitating faster permit turn-arounds, and generally not subjecting adaptive reuse projects to the same scrutiny

experienced by new construction, mixed-use could be incorporated into projects thereby incorporating business and retail space at street level with housing units above (Rosenberg, 2012). LA's action is an example of just one locality implementing supportive policy for adaptive reuse that can be replicated at any level.

Not all sustainability incentive programs are inherently effective. For example, the Leadership in Energy and Environmental Design (LEED) system awards points for features like showers and bike racks, which are intended to encourage carbon-neutral transportation such as cycling (USGBC, 2025). The more points earned, the higher LEED certification a building can earn. Interestingly, LEED allocates points for a minimum 50% surface area reuse. However, only two points maximum can be earned for this category. For further context, LEED Gold Certification requires upwards of 60 points and is not the highest certification achievable. Although LEED is widely recognized, criticism about the program specifically around the effective nature of LEED as a tool for promoting green building practices is an ongoing discussion. In fact, in a 2013 examination of the effectiveness of LEED, Boschmann and Gabriel write that LEED "fosters a popular, if not narrow understanding of sustainability through green building" (p. 222). Furthermore, Boschmann and Gabriel go on to criticize LEED for being a market driven program and ultimately conclude that LEED falls short in two ways; in effectiveness at promoting environmentally-forward building practices, and failure to account for a building's relationship to its geography. In short, and as Boschmann and Gabriel write, there is no one-size-fits all approach to calculating a building's sustainability potential (2023, p. 222). As it relates to adaptive reuse, these criticisms of LEED point to local leaders and organizations as the knowledge-bearers for measuring sustainability and providing a built environment that serves local communities. There is also a warning to heed in these criticisms of LEED, that communities must hold our leaders accountable to higher standards when it comes to transparency and the development of green building incentive programs.

Conclusion

Using materials already present in the built environment reduces greenhouse gas emissions by eliminating emissions that would have been produced from raw material processing. Simply put,

adaptive reuse is the concept of recycling applied to the built environment. What is already in place, be it an abandoned office building, storage facility, or airplane hanger, has materials that can be left in their existing form and used to serve a new purpose such as a mixed-use shopping center, affordable housing, or a public library.

Buildings that contribute to the character of a neighborhood or that the surrounding community has a connection to can be incentives to reuse the existing buildings and preserve those ties. In acknowledgment of a history of systematic neglect of our societies' most vulnerable populations, it is important to remember that the built environment can contribute to social issues, or it can try to address them in innovative, new ways. None of this can be accomplished without the support of government and institutions that facilitate incentive for sustainable projects to take shape. Legislation that encourages green building practices will create a sustainable, equitable built environment that balances the needs of people and preservation of the environment.

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