

Sustaining The Sustainable Building

Advisory Document

Lessons for High Performance Building Operations & Design

SUMMER 2026 - Jeremiah Dang

The Kendeda Building for Innovative Sustainable Design

Georgia Institute of Technology

Georgia Institute of Technology

Sustaining The Sustainable Building

Advisory Document - Lessons for Resilient Building Operations & Design

SUMMER 2026 - Jeremiah Dang
The Kendeda Building for Innovative Sustainable Design

Table of Contents

Acknowledgements ..... Page 4

Executive Summary ..... Page 5

Introduction ..... Pages 6 - 7

Anecdote 6

Quotes from Professionals 7

Lessons From Building Operations & Maintenance ..... Pages 8 - 12

Introduction 8

The Evolution of Sustainability Phases ..... 9 - 10

The Sustainability Bottleneck 11

Case Study 1 12

Lessons From Site Operations ..... Pages 13 - 16

Introduction 13

A New Kind of Passive Design ..... 14 - 15

Re-Emphasizing Place 16

Case Study 2 & 3 17

Lessons From Social Systems & Human Operations ..... Pages 18 - 20

Introduction 18

An Over Emphasis on Aesthetic Sustainability 19

The Challenges of Passion-Driven Infrastructure 20

Case Study 4 21

Solutions & Adaptations ..... Pages 21 - 23

Treating Buildings like Living Systems ..... 21 - 22

Integrated Project Delivery (IPD) Thinking 23

Conclusions ..... Pages 24 - 25

Call to Action & Final Word 24- 25

Glossary & References ..... Pages 26 - 28

Glossary 26- 27

References 28

Acknowledgements

PERSONAL ACKNOWLEDGEMENTS

I am profoundly grateful for the significant contributions of all participants in the *Sustaining the Sustainable Building - Advisory Document* input, interview, and review processes. As an advisory document, no change is possible without feedback and inquiry from our community. Thank you to all of the incredible building operators, facilities managers, maintenance crews, horticulturists, custodians, architects, authors, and trail-blazers in the field of high performance buildings who brought comprehensive program knowledge, experience, ambition, and support.

I would like to extend a special acknowledgment to the following people who have provided ongoing support, review, and technical expertise:

- ***Shan Arora***, ***Brooke Johnson***, ***Cindy Spalding***, ***Alejuandro Hunt***, ***Steve Place,*** & ***Monique Thornton*** (Georgia Institute of Technlology, Atlanta, GA)
- ***Tressa Points*** (PAE Living Building, Portland, Oregon)
- ***Dane Lovell*** (Stanley Center for Peace and Security, Muscatine, IA)
- ***Addison Olson*** (Theodore Roosevelt Presidential Library, Medora, ND)
- ***Erica McBride*** (Architectural Nexus, Sacramento, CA)
- ***P.J Melton*** & ***Brent Ehrlich*** (BuildingGreen)

Thank you to everybody who works in and with high performance buildings and their generous commitment to helping elevate non-traditional voices in the built environment.

INDUSTRY ACKNOWLEDGEMENTS

The buildings and sites mentioned in this advisory document are a testament to the ever-growing movement to make the built environment more sustainable, regenerative, and resilient. As an educational piece, this document acknowledges the difficulty in the sustainable design field of going against the grain and being radical for the sake of change, seeing growing pains as opportunities for growth rather than failures in a system. The intention of this document is not to criticize these building designs but to offer the real-life lessons building managers, operators, and so many from across the building field have learned from working in these spaces. We also want to express our appreciation for what the field represents and to honor the architects, engineers, contractors, and all who helped create these remarkable places.

ABOUT THE KENDEDA BUILDING FOR INNOVATIVE SUSTAINABLE DESIGN

The Kendeda Building for Innovative Sustainable Design is Georgia's first Living Building Challenge–certified project, achieving the world's most ambitious holistic high-performance building standard. Rather than being "less bad," it advances regenerative and resilient systems that give back more than they take. It operates as a net-positive energy and water facility, began its life net-zero carbon, diverted more waste from landfill than it sent, and was built using some of the healthiest materials available.

Executive Summary

This advisory document evaluates the operational reality of high-performance, regenerative buildings after occupancy, bridging the gap between schematic design optimism and long-term facilities management. Centered on field findings, interviews, and elicitation from many different disciplines across a plethora of high-performance buildings and sites, this document examines how, in practice, highly complex, novel buildings may encounter unforeseen operational difficulties and maintenance costs. There are knowledge gaps between the architectural intent of regenerative design and the daily, practical reality of facilities management, which may lead to inefficiencies that simpler, passive solutions could avoid.

The primary aim of this advisory document is to provide those who work in the built environment with a practical, field-tested playbook that identifies which regenerative strategies excel in practice and which may introduce unnecessary complexity, ensuring that next-generation sustainable buildings are as operationally resilient as they are environmentally ambitious.



Theodore Roosevelt Presidential Library

Introduction

ANECDOTE

The ongoing saga of the Kendeda Building's automated exterior blinds serves as a cautionary tale regarding the implementation of advanced green mechanical systems. Seven years ago, during the building's "soft opening" period, an individual locked their bike to the building's exterior blinds system that blocked solar heat gain during sunsets. The small action broke a large portion of the exterior blinds system, and it has not functioned properly since then.

Due to gaps in technician knowledge, standard campus maintenance crews are unable to service the automation, with the nearest available company located in Europe. The problem was not that the blinds broke; the problem was that we did not have the expertise or resources to fix them. When an asset meant to make a building more sustainable becomes its own liability, it inherently degrades the efficiency of the overall system.

This incident at the Kendeda Building highlights an issue in the high-performance building field, where design intent and operational reality sometimes clash when they never should have. Project team members now say that if they could do it again, rather than spend money on exterior blinds, they would have invested those funds on taller trees. Trees planted seven years ago are now tall enough to reduce the heat gain and fulfill the purpose of the exterior blinds. It turns out the passive, simpler solution has proven itself to be more regenerative, cost-effective, and efficient. At what point are we making sustainable buildings too complicated?



Under the "Regenerative Front Porch" at the Kendeda Building (exterior blinds on left)

Introduction

QUOTES FROM PROFESSIONALS

• Shan Arora – Building Director (Kendeda Building, Georgia Tech)

"Very soon after opening... we learned the power of diverse voices in the room."

• Brooke Johnson – Facilities Manager & Building Operator (Kendeda Building, Georgia Tech)

"So that is the simpler system that I can rely on really well… there are possibly more opportunities for failure because it is more complicated with the machinery and equipment."

• Alejandro Hunt – Campus Area II Maintenance Manager (Georgia Tech)

"The design was supposed to be simple and straightforward... but from the operational perspective it's not something easily maintained."

• Steve Place – Site Horticulturist & Campus Sustainability Program Manager (Georgia Tech)

"There must be a willingness to adopt regenerative ecology and we as humans want to manage everything… a technology bias…"

• Dane Lovell – Facilities Maintenance Superintendent (Stanley Center for Peace & Security)

"Sometimes engineers like to overengineer things... the processes that have been in play for two hundred or three hundred years, utilizing gravity, do not rely on technology."

• Tressa Points – Office & Interim Building Operations Manager (PAE Living Building)

"With the uniqueness of these buildings, having in-house building management is golden... we get pushed to the bottom of the line sometimes... it's better to have one to two people who know the systems and have been consulted during the build out."

• Erica McBride – Building Operations Manager (Arch Nexus)

"It [a Living Building] is like a baby... you have to know how it cries, how it talks, how it sounds... when walking into the mechanical room, from the sound you should know if there is a problem."

• Addison Olson – Sustainability & Operations Project Coordinator (Theodore Roosevelt Presidential Library)

"I cannot stress enough how important it is to think about how, during operations, what are some things that are going to happen daily that we need to make sure we have the capacity to do… this was definitely an oversight that was not thought about until way later when it was too late to fix."

Lessons From Building Operations & Maintenance

INTRODUCTION

The ultimate success of a high-performance building is determined long after the ribbon-cutting ceremony and certification plaques are installed. While the schematic design and construction phases of high-performance buildings are driven by visionary ecological goals, post-occupancy management reconciles with daily operational realities. Sometimes, a design choice made to satisfy strict environmental standards can transform into a long-term operational vulnerability for facilities management.

This section evaluates and documents the friction encountered by facilities teams managing high performance and sustainable buildings across their operational lifecycles. It draws on real-life experiences by professionals detailing the kinds of liabilities that may emerge when visionary design meets restrictive trade environments. Specifically, this analysis focuses on three recurring operational challenges that occur during a building's evolution: sustainability bottlenecks, vendor/operational backlash, & maintenance friction.



PAE Living Building

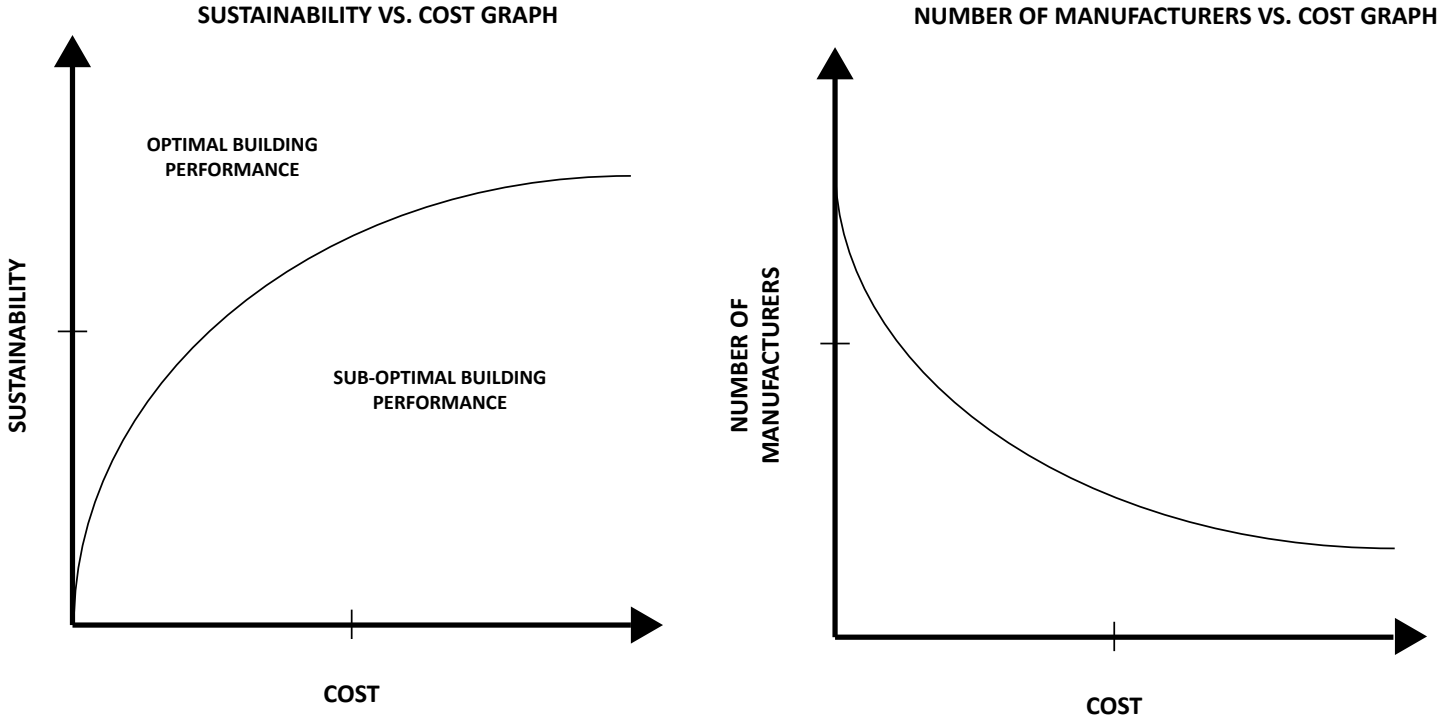
Lessons From Building Operations & Maintenance

THE EVOLUTION OF SUSTAINABILITY PHASES

The lifecycle of a high-performance facility does not automatically guarantee long-term performance, and without deliberate risk management, a project risks drifting through three distinct sustainability phases that can compromise both its ecological returns and financial viability.

1. The Inefficiency Zone (Design Phase Risk): During early planning, project teams risk misallocating capital by relying or investing too early on complex, high-maintenance technologies. If teams are not careful, they pay an inflated premium for low-yield systems when equivalent sustainability metrics could be achieved far more reliably through simple passive strategies like optimized orientation, robust insulation, and standard regional material sourcing.

2. The Operational Deficit (Reality Phase Drift): Even a building designed to sit precisely on the optimal performance curve can gradually sink into suboptimal performance once occupied. This gap emerges when daily maintenance friction, such as specialized vendor delays, unobtainable custom parts, or bypassed controls, causes systems to go offline. An example of this is the kind of special soaps needed for foam flush toilets (Kendeda Building) or can even be simple conventional products and items, but due to isolation may become “luxuries” for buildings far from cities (Theodore Roosevelt Presidential Library). Left unaddressed, buildings risks absorbing the premium operating cost of a Living Building while falling short of Living Building design goals.



Sustainability X Cost Graph Highlighting Diminishing Returns on Sustainability (Left)

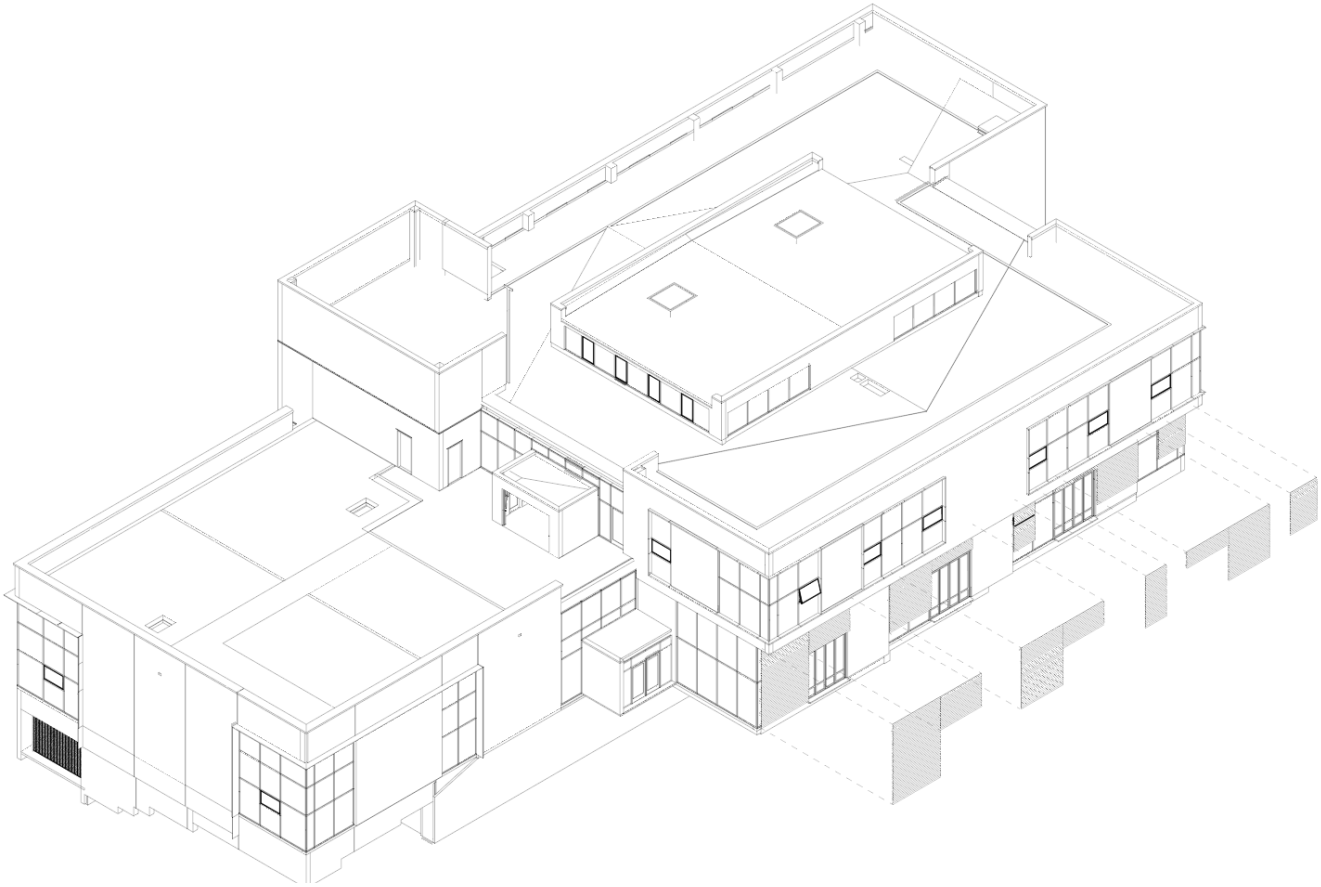
Number of Manufacturers X Cost Graph Highlighting Increasing Cost (Right)

Lessons From Building Operations & Maintenance

THE EVOLUTION OF SUSTAINABILITY PHASES (CONTINUED)

3. The Unjustified Premium (***Green Premium***) Phase: The highest chance for financial dangers occurs when ongoing operational deficits push a project below the performance threshold into the Unjustified Premium. An example of this is the high prices sometimes pushed onto high-performance buildings during maintenance of their mechanical systems, charging premium prices due in part to vendor scarcity. In this scenario, a building bears the full weight of upfront capital costs and recurring maintenance spikes, enduring a “Green Tax” yet failing to harvest the expected energy, water, or ecological rewards because daily operational friction and market scarcity have forced daily workarounds or system shutdowns.

Vendor backlash/conflict may also be incurred during this period due to a refusal to adhere to often strict guidelines. Across the high-performance building field, it’s been recorded that that vendors, when faced with the added cost and strictness of Red List, Declare, or other green compliances, will sometimes walk away from a project entirely leaving facilities teams to deal with the issue on their own.



Exterior blind system on the west side of the Kendeda Building for Innovative Sustainable Design

Lessons From Building Operations & Maintenance

SUSTAINABILITY BOTTLENECKS

When designing for rigorous environmental certifications, project teams must proactively navigate a severe market squeeze known as the ***Sustainability Bottleneck***. Layering strict performance criteria, such as low-embodied carbon mandates, regional sourcing requirements, ***Red List*** vettings, and detailed documentation requirements, can restrict the pool of compliant manufacturers and service providers, leaving long-term operations relying on a small list of specialized vendors who hold a lot of leverage.

To protect a facility from these vulnerabilities, teams should prepare for risks across both logistical and human domains. Logistically, when a failure occurs, buildings may be forced to confront prolonged downtimes and predatory emergency repair rates when standard local teams lack expertise to service the infrastructure. On the human side, the more complex the system, the more additional training will be required for those who operate and maintain these systems day to day. For all buildings, time is money, and this human friction may appear in continuous onboarding and high rates of turnover for employees.

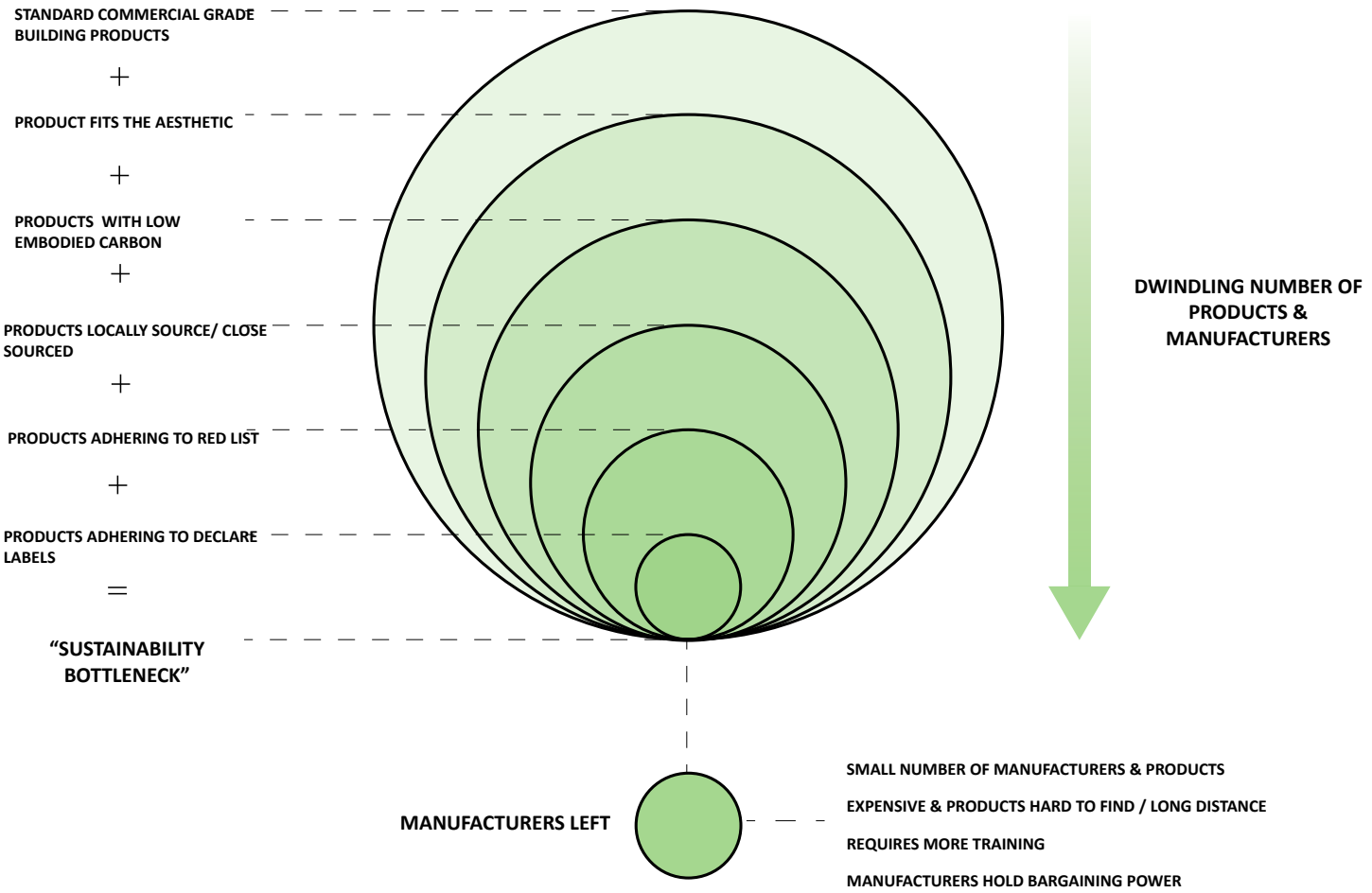


Diagram Showing the Creation of a Sustainability Bottleneck and its Repercussions

Lessons From Building Operations & Maintenance

CASE STUDY

Case Study 1: Architectural Nexus (Sacremento, California)
When a specialized manufacturer discontinues a niche product, facilities management faces a critical risk where a simple repair may require a compromise of a building's sustainability standards. In high-performance buildings, components are often specified to satisfy strict material requirements at a single "snapshot in time." However, as manufacturers change, products disappear and supply chains shift, maintaining this material integrity post-occupancy becomes challenging.

This operational vulnerability was demonstrated during an exterior wall repair at the Arch | Nexus SAC building a couple years ago when, during a tear-down to fix drainage issues, the team realized the original manufacturer for custom-made Galvalume-free metal panels powder-coated white to meet Red List exclusions had become discontinued. Had any of these panels broken during removal, their only option would have been to compromise the building's Red List integrity by buying standard galvanized panels and field-painting them to match.



Exterior Shot of Architectural Nexus Highlighting the Urban Context

Lessons From Site Operations

INTRODUCTION

True operational resilience is not just built into the machinery but into the biology of the site. Sometimes human intervention in nature unintentionally introduces fragile, expensive failure points where passive design instead could thrive and prove cheaper and more resilient. Building organic soil layers, utilizing natural shade, protecting microclimates, and fostering biodiversity allows a building's grounds to self-regulate without continued mechanical intervention. We routinely underestimate site dynamics, whether it be from where we place our building to undervaluing nature's inherent ability to sustain and thrive.

This section evaluates and documents the unexpected difficulties encountered by site managing teams beyond the walls of the building. It draws on real issues that may emerge when planned site design meets the natural ecosystem. Specifically, it hones in on the need for a broader interpretation of passive design in the landscape and cautions against underestimating site dynamics and the raw power of place. If we are to create a living system capable of sustaining itself, we must stop trying to engineer our way out of site realities and instead design systems simple and grounded enough to let the site itself do the heavy lifting.



Stanley Center for Peace & Security Outdoor Garden

Lessons From Site Operations

A NEW KIND OF PASSIVE DESIGN

Oftentimes passive design is thought of in terms of just the building and its envelope. Passive heating/cooling, shading, and ventilation are all concepts familiar to architects and designers when utilizing natural means in order to lower energy use and reliance on heavier mechanical solutions. However, when it comes to the natural landscape and site operations, a broader interpretation of passive design should be enacted. Why does passive design stop at just the building?

Regenerative ecology is one of the best ways to introduce passive design into the site and build resiliency by utilizing nature's best strengths. On places like rooftop gardens, known for their hostility, heat, and poor soil quality, instead of relying on mechanical drip irrigation systems, invest in building a "soil sponge." These are organic layers of mulch and natural organic matter, which can help cool, water, and passively store rainwater for the soil. An added benefit to this passive solution over the mechanical solution is that it allows for the system to "fall softly," instead of all at once, with any inevitable failures being more likely to degrade slowly rather than suddenly.



Rooftop Garden of the Kendeda Building for Innovative Sustainable Design

Lessons From Site Operations

A NEW KIND OF PASSIVE DESIGN - CONTINUED

When protecting the site, instead of insecticides, pesticides, and other non-natural and non-passive means to keep our sites and gardens healthy, rely on plant biodiversity as the first point of defense. This passive approach strengthens garden spaces and landscapes that allow for plant resiliency in the event that one species inevitably struggles during a harsh season. Here other plants and insects will be able to fill the ecological gap to keep the site functioning healthy without the need for popular mechanical irrigation or chemical approaches.

Overall the natural, passive, regenerative solution relies on biodiversity and nature's own resilience to ensure that when a system experiences extreme weather or minor neglect, it degrades gracefully rather than suffering total collapse. Pushing for this expanded definition and application of what it means to "passively design" means investing in establishing strong, natural, and self reliant foundations in the environments that we are building. In the high-performance, sustainable, and especially regenerative field, the building and site are one living system.

LESSONS FROM SITE OPERATIONS - IN QUOTES

"*True resilience isn't about building a system that never experiences stress. It's about designing it so that when things fall, they fall softly.*"

"*We were trying to grow native Georgia plants in an engineered soil that was 60% sand. The water ran straight through it like a sieve, while the plants' biology was begging for clay.*"

"*In a climate with 50 inches of rain a year, irrigation is an insurance policy for the first year. After that, if you've built the soil, the site will take care of itself.*"

- Steve Place



Constructed Wetland & Entrance to the Kendeda Building for Innovative Sustainable Design

Lessons From Site Operations

UNDERESTIMATING THE POWER OF PLACE

When speaking to the numerous teams who manage the building site, whether it be the rooftop garden, the bioswales, or the grounds, the same warnings and general feelings are heard. “We underestimated the power of place.” Even for the horticulturists, permaculturists, and area managers who consistently work with the forces of nature, they are constantly surprised by both its vibrancy and resiliency.

When design assumes an idealized site environment, the real-world friction of physical context, historic preservation guidelines, urban overshadowing, and severe geographic remoteness can cause post-occupancy performance drift. A living building cannot be engineered in a vacuum. Whether it is an urban historic board restricting solar geometry (PAE Living Building), neighboring buildings casting unmodeled shadows (Stanley Center), or geographic isolation stripping a facility of spare parts and waste access (Theodore Roosevelt Presidential Library), site operations will always be dictated by its physical context. Design teams must acknowledge surrounding urban structures, local trade demographics, and back-of-house operations with the same intensity as they do with carbon.

UNDERESTIMATING PLACE - IN QUOTES

“*There are a lot of operational implications in the Living Building Challenge that I don’t think were thought of before since they were so focused on design and construction, but now when we are in the operations phase… How are we going to do that? How can we find contractors in an MWDBE [Minority, Women, and Disadvantaged Business Enterprise] business when there aren’t any?*”
- Addison Olson (Theodore Roosevelt Presidential Library)

“*If we’re going to take these buildings in ecosystems where wildlife lives, we have to incorporate things for wildlife… What it teaches for future iterations of LBC guidelines is that it is something to consider if you are putting your building in certain transects… something that needs to be worked into the language of the certification itself.*”
- Erica McBride (Architectural Nexus)





Wildlife in the Badlands of North Dokota

Lessons From Site Operations

CASE STUDIES

Case Study 2: Stanley Center for Peace & Security (Muscatine, Iowa)
When retrofitting a 1970s library building into a 19,260-square-foot living building, the Stanley Center installed 344 solar panels across two canopies. However, 3.5 years post-occupancy, the facility still fails to hit its required 105% net-positive energy target. The culprit is its own physical context, where adjacent 3-story and 7-story buildings cast significantly more shade onto the solar arrays than was anticipated in early energy models.

Case Study 3: Theodore Roosevelt Presidential Library (Medora, North Dakota)
Located 35 minutes from Dickinson, ND (a population of 26,000), the presidential library suffers from multi-week bottlenecks due to zero overnight shipping access with ordering parts as mundane as magnets to far more unique specialized repair parts. Furthermore, fulfilling the LBC equity mandates (MWDBE contractor quotas) is a statistical challenge where only 10 MWDBE registered businesses exist in the entire state, forcing operations to search across state lines into Montana and South Dakota.



Map of Theodore Roosevelt Presidential Library Site (Rural & Isolated Area)

Lessons From Social Systems & Human Operations

INTRODUCTION

High-performance architecture is fundamentally a human system. Its real-world success is determined by the daily decisions and physical capacity of the people who maintain it. To be cautioned is the implementation of complex ecological or mechanical systems that may be deemed as “passion-driven infrastructure.” What happens when these systems flourish only under a deep passionate team effort rather than being self-reliant? When these over-engineered systems lack support, initial enthusiasm may dissolve into operational slowdown and mismanagement as staff turnover and buildings age. If a system florishes on passion alone, how sustainable was it designed in the first place?

This section evaluates and documents the human and social blind spots encountered by design and planning teams in the design and building process. It draws on real social system issues that may emerge in the building operations field long after construction. Specifically, it hones in on the need for simple design that values operational sustainability, efficiency, and long-term self-reliance rather than aesthetics or passion.



Indoor Greenery of the Arch Nexus Building

Lessons From Social Systems & Human Operations

AN OVER EMPHASIS ON AESTHETIC SUSTAINABILITY

Prioritizing aesthetic sustainability over operational sustainability directly transfers design ambition onto facilities staff as physical labor, elevated safety risks, and daily friction. Whether elevating water catchment systems to high clearances for visual impact, making routine filter inspections difficult, or concealing waste infrastructure in an indoor garage at the Theodore Roosvelt Presidential Library to preserve pristine sightlines, hiding utilities undermines basic human operations. When thinking about how a sustainable building should be designed, too often do designers prioritize implementing rooftop gardens, indoor greenery, and aesthetic green systems before fully optimizing their operational sustainability.

Oftentimes the most efficient buildings will not be the flashiest. They will rather rely on the unglamorous drivers of performance like airtight thermal envelopes, simple low flush toilets, and a focus on low-carbon and healthy materials. Ultimately, building high performance is measured by its long-term reliability, longevity, and resiliency, not its visual symbolism.



Interior of PAE Living Building

Lessons From Social Systems & Human Operations

THE CHALLENGES OF PASSION DRIVEN INFRASTRUCTURE

Passion-driven infrastructure, however well-intentioned, is structurally vulnerable and should be cautioned in sustainable building design. An uncomfortable truth is that if a green building's living systems depend on a full, passionate effort of everybody on a team, the design itself has failed at its core mandate regardless of how ecologically sound its intentions were. What may look like a thriving, self-sustaining site ecosystem may in reality be held together by expertise, passion, and experience that may be difficult to replicate or replace.

This points to a deeper principle in that sustainable architecture must be designed for the indifferent user, not the enthusiast. Systems must be resilient enough to survive standard, conventional, or low-level maintenance protocols, or they become increasingly vulnerable to degradation once time passes and buildings age. True operational sustainability, then, requires treating human energy as the finite resource, prioritizing intuitive, maintainable systems over aesthetic novelty and technological complexity, so that a building's ecological performance isn't in question the moment the people who cared the most walk out the door.

THE CHALLENGES OF PASSION DRIVEN INFRASTRUCTURE - IN QUOTES

"One of the interesting things that comes with this [Living Buildings] is that trying to build a flagship building that is supposed to push the boundaries of everything and by doing so you are setting yourself up for these challenging situations down the road… I applaud them…"
- Brent Ehrlich

"Especially where we are, we have some of that negative stigma when it comes to the word 'sustainability'… depending on who I am in the room with, I cannot use that word."
- Brooke Johnson



Bioswales on the grounds of the Kendeda Building for Innovative Sustainable Design

Lessons From Social Systems & Human Operations

CASE STUDIES

Case Study 4: Kendeda Building for Innovative Sustainable Design (Atlanta, Georgia)
When the Kendeda building's dedicated horticulturist left, grounds management reverted to standard landscaping crews who did not have the same level of regenerative ecological training. Due to this over time the carefully maintained ecosystem started to weaken with agressive native and invasive non-native species taking over. This led to an unstable ecological balance due to a combination of disregard for existing plants, underweeding, and planting of leftover plants in the garden that altered the vegetative makeup of the rain gardens and bioswales.

"Sustainable" and "low-maintenance" are not the same thing. The garden looked self-sufficient once established, but it wasn't self-sustaining enough; it required constant intervention (weeding, composting, and adaptive replanting) to stay in the state it was designed for. Once that knowledge left, the system didn't hold steady. The gardens' plight indicates a need for a self-reliant, passively designed site that won't rely fully on either mechanical systems or humans to keep them thriving.



Site view of the Stanley Center for Peace & Security (Note the seven story building on left)

Solutions & Adaptations

TREAT BUILDINGS LIKE LIVING SYSTEMS

Adaptation is not a weakness in Living Buildings; it is the very mechanism by which they mature into more resilient, more equitable, and more widely achievable models of sustainability. Ultimately, this points to a broader shift in thinking required across the sustainable building movement in that buildings must be treated not as fixed, finished products, but instead as living systems that grow, fail, and adapt over time like all living systems do.

A truly sustainable building cannot be expected to perform flawlessly from day one. Failure is not evidence that the system is broken; it is itself what allows the system to learn. A rooftop garden that loses a crop to heat stress, or a materials standard that proves too rigid for widespread adoption, is not proof that sustainability doesn't work; it is instead feedback that a living system can use to stregthen itself. To build sustainably is to accept that some things will not work as intended, and to adapt is to allow those failures to become the foundation for something more resilient, more efficient, and more long-lasting than what came before.

CASE STUDY: LIVING BUILDING CHALLENGE

The Living Building Challenge itself, the current highest green building achievement standard in the world, chose to lower its Materials Petal vetting requirement from 100% to 90% specifically to make compliance achievable for a broader range of projects. This change recognized that an overly rigid standard will weaken the ability for buildings to showcase their own unique features.

Similarly, the Challenge restructured its recognition system to celebrate the achievement of individual petals rather than requiring all petals be earned simultaneously. This equity-minded shift acknowledged different buildings, budgets, and climates. This meaningful progress deserves recognition even when it's partial. These are not concessions to lower standards, instead they are adaptations that help widen the path toward the standard, allowing more projects, in more places, with more varied resources, to participate in and showcase genuine sustainable achievement.

2025 LBC Red List CASRN Guide - Number of CASRNs per Category*

CHEMICAL CLASS or LIST	RED LIST	PRIORITY LIST	WATCH LIST
Alkylphenols and related compounds	405	114	
Antimicrobials (marketed with a health claim)	2	9	13
Asbestos compounds	27		
Bisphenol A (BPA) and structural analogues	46		
California-banned solvents	12	1	11
Chlorinated Polymers	134		
Chlorobenzenes	18	1	
Chlorofluorocarbons (CFCs) and hydrochlorofluoro-carbons (HCFCs)	171	2	
Formaldehyde (added)	33	1121	1
Monomeric, polymeric, and organophosphate haloge-nated flame retardants (HFRs)	270	1154	
Per- and Polyfluorinated Alkyl Substances (PFAS)	10785	31	
Phthalates (orthophthalates)	39	550	
Polychlorinated biphenyls (PCBs)	239		
Polycyclic aromatic hydrocarbons (PAHs)	97		
Short-chain and medium-chain chlorinated paraffins	4	34	
Toxic heavy metals	353		3
Volatile organic compounds (VOCs) in wet-applied products**			
Wood treatments containing creosote or pentachlo-rophenol	35		
C1-C4 halogenated hydrocarbons		39	117
Asphalt			2
Stoddard solvent		1	
Diisocyanates		24	
Organophosphate ester flame retardants		202	
Organotin compounds		202	
EU REACH Annex XIV - Authorization List		110	
EU REACH Annex XVII - selected entries		34	
EU CLP Annex VI CMRs		2752	
EPA Ozone Depleting Substances		112	
Kigali Amendment (under AIM Act)		11	
TSCA 40 CFR 751 PBTs		4	
Stockholm Convention - Persistent Organic Pollutants		336	

*Some chemicals fit under multiple classes, and/or are listed on multiple regulatory lists. The LBC Red List CASRN Guide removes all duplicates, so the sum of all CASRNs in this table is larger than the number of CASRNs listed in the Guide.
**Volatile organic compounds (VOCs) in on-site wet-applied products are not banned, but must have VOC levels below the South Coast Air Quality Management District (SCAQMD) Rule 1168 for Adhesives and Sealants or the CARB 2007 Suggested Control Measure (SCM) for Architectural Coatings, as applicable.

Red List of the Living Building Challenge (LBC)'s Material Petal

Solutions & Adaptations

INTEGRATED PROJECT DELIVERY (IPD) THINKING

The principles of Integrated Project Delivery (IPD) are relevant to building projects regardless of whether they are considered “sustainable.” While green building certifications often encourage greater coordination and integration among project participants, issues highlighted in this document are inherent in all construction. With conventional buildings, the shortfalls may be accepted as “the cost of doing business” or met with a response “that’s the way it’s always been done.” However, the intentionality involved in designing and constructing a high-performance building creates a greater responsibility for the project team to address these challenges from the outset. Achieving a high level of performance at the time of completion is only part of the goal; the project team must also consider how the building will be operated, maintained, and adapted so that it can continue to perform to those standards for decades after opening.

But more IPD, on its own, is not enough. It asks the right people to attend the meeting, but it does not necessarily change how the people already in the room think. What’s needed alongside broader collaboration is a deeper shift in mindset among architects and designers themselves. A willingness to think like operators, not just like designers. The solution here is to not just push for more IPD and diversify the people at the table but to diversify the way we think about our designs, especially if we are to claim them as sustainable and regenerative.



Indoor Atrium Level of the Kendeda Building for Innovative Sustainable Design

Conclusions

CONCLUSIONS - CALL TO ACTION

The case studies in this document are symptoms of a single, correctable habit: treating operations as an afterthought to design. The path forward requires three concrete shifts:

1) Invite operators to the table before the first drawing is final. Facilities managers, maintenance crews, and horticulturists must be present during schematic design, not consulted during commissioning. They are the ones who will live with every mechanical, material, and planting decision for decades.

2) Interrogate every ***Green Bling*** feature against a simple test: Can this be maintained by a standard, regionally available technician, without specialized training? If the answer is no, the feature should be justified by exceptional performance gains, not aesthetics or novelty.

3) Build for the indifferent user, not the passionate one. Design systems, mechanical, ecological, or social, that survive staff turnover and budget cuts. A building's sustainability credentials must hold up in the maintenance logs ten and twenty years from now, not just on opening day.

This is a call to architects, engineers, campus planners, and building owners alike: sustainability is not proven at the ribbon-cutting. It is proven, or lost, in the years of ordinary, underfunded, imperfect operation that follow.



Opening Door to Regenerative Front Porch in the Kendeda Building for Innovative Sustainable Design

Conclusions

CONCLUSIONS - FINAL WORD

A building is not a finished product; it is a living relationship between design and the people who inhabit and maintain it. The Kendeda Building's blinds failed, but the trees the project team planted grew tall enough to do the job instead. That is not a story of failure, it is a story of a system learning, adapting, and finding its own resilience, exactly as this document argues it should. The next generation of high-performance buildings will not be defined by how ambitious their buildings green systems are, but by their ability to bend, adapt, and grow long after the passion of their original designers and operators have moved on.

Sustainability, in the end, is not a plaque on the wall, it is a practice, sustained.



Structural System of the Kendeda Building for Innovative Sustainable Design Showcasing Mass Timber

Glossary

GLOSSARY

• **Aesthetic Sustainability** - The prioritization of an overt “sustainable look and feel” designs such chosen by designers primarily to visually communicate ecological intent, express green design prestige, or satisfy certification imagery, often without any actual relation to effiency or operational sustainability.

• **Green Bling** - Superficial, highly visible, or novelty eco-features added to a building primarily for visual appeal or marketing clout, sometimes carrying higher capital costs or maintenance burdens, without delivering proportional ecological or performance value.

• **Green Premium** - The additional upfront capital and long-term financial markup paid for sustainable materials, specialized systems, certified components, and expert labor compared to conventional, standard building practices.

• **Integrated Project Delivery (IPD)** - A collaborative project delivery approach that aligns the interests, risks, and rewards of the client, architect, engineers, general contractor, and key facilities stakeholders from pre-design through post-occupancy to ensure long-term operational success.

• **Living Building Challenge (LBC)** - The Living Building Challenge (LBC) is a rigorous, performance-based sustainable building certification program and philosophy created by the International Living Future Institute. Organized around 7 petals (Place, Water, Energy, Health + Hapiness, Equity, and Beauty) the LBC shifts the design goal from merely “doing less harm” to creating regenerative buildings that actively give back to the environment, producing more energy and clean water than they consume.

• **Operational Sustainability** - The practical, day-to-day reality of maintaining a building’s environmental and energy performance over its entire lifecycle. This focuses on the ease of servicing mechanical systems, sourcing replacement parts, managing supply chain constraints, enforcing access protocols, and keeping facilities functioning comfortably without imposing excessive maintenance burdens, specialized vendor dependencies, or runaway labor costs on facilities staff.

• **Passive Design** - An architectural strategy that utilizes natural elements such as building orientation, natural ventilation, daylighting, thermal mass, and solar shading to maintain occupant comfort and reduce energy loads without relying on complex, powered mechanical equipment.

• **Red List** - The Living Building Challenge (LBC) Red List is a list of chemicals representing the “worst in class” substances prevalent in the building industry that pose serious risks to human health and the environment.

• **Regenerative Design** - A holistic design paradigm where a building is engineered to function like a natural ecosystem actively producing more energy than it consumes, harvesting and treating all its own water, and restoring the health of its surrounding ecological and human community.

• **Regenerative Ecology** - An environmental framework that goes beyond merely reducing harm or achieving “net-zero” impacts, aiming instead to design built environments that actively restore local ecosystems, enrich

Glossary

GLOSSARY CONTINUED

• **Resilient Design** - The practice of designing buildings and infrastructure to withstand, adapt to, and rapidly recover from severe disruptions including climate impacts, power outages, supply chain failures, vendor lockouts, and mechanical breakdowns ensuring continuous, long-term functionality.

• **Sustainability Bottleneck** - An operational operational delay or maintenance failure caused when strict ecological standards (such as Red List chemical bans or single-source green certifications) limit available vendors, stall supply chains, or require unobtainable custom replacement parts.

• **Sustainable Design** - An architectural and engineering approach focused on minimizing negative environmental impacts through energy efficiency, resource conservation, waste reduction, and the selection of low-impact materials to maintain balance without depleting future resources.

• **Thermal Envelope** - The continuous physical barrier of a building comprising the roof, exterior walls, high-performance glazing, doors, and foundation that isolates the conditioned interior environment from exterior weather conditions to control heat transfer, air leakage, and moisture.

• **Up-Front Soft Costs** - Non-physical development expenses incurred during early planning, design, and permitting phases including specialized engineering consultancies, LBC/LEED certification fees, advanced energy modeling, legal reviews, and custom commissioning.

References

NOTE - Images used for this publication are either available in the public domain or used with consent of the project referenced.

"About The Kendeda Building | The Kendeda Building for Innovative Sustainable Design." 2021. Gatech.Edu. 2021. https://livingbuilding.gatech.edu/about.

"Arch | Nexus SAC." n.d. International Living Future Institute. 2026. https://living-future.org/case-studies/arch-nexus-sac/.

Cramer, and Evan. 2024. "The Stanley Center for Peace & Security- Design Engineers MEP." Design Engineers MEP. https://designengineers.com/2024/07/the-stanley-center-for-peace-security/.

"Georgia Tech Kendeda- GREEN | Lord Aeck Sargent." 2026. Lord Aeck Sargent. https://www.lordaecksargent.com/portfolio/deep-green/gt-kendeda.

"Georgia Tech The Kendeda Building for Innovative Sustainable Design » Newcomb & Boyd." 2024. Newcomb & Boyd. May 28, 2024. https://www.newcomb-boyd.com/project/georgia-institute-of-technologythe-kendeda-building-for-innovative-sustainable-design/.

"Healing Ground, Living Values: Stanley Center for Peace and Security." 2026. Living Future. 2026. https://store.living-future.org/products/healing-ground-living-values-stanley-center-for-peace-and-security.

"Homepage." n.d. Theodore Roosevelt Presidential Library. 2026. https://www.trlibrary.com/.

"Kendeda Building for Innovative Sustainable Design at the Georgia Institute of Technology- Greenroofs.Com." 2026. Greenroofs.Com. April 8, 2026. https://www.greenroofs.com/projects/kendeda-building-for-innovative-sustainable-design-at-the-georgia-institute-of-technology/.

Nadine M. Post. 2024. "PAE Living Building Team Shares Lessons Learned." ENRnews. May 29, 2024. https://www.enr.com/articles/58730-pae-living-building-team-shares-lessons-learned.

Neumann Monson Architects. 2025. "The Stanley Center for Peace and Security | Neumann Monson Architects." Neumannmonson.Com. https://neumannmonson.com/the-stanley-center-for-peace-and-security.

"PAE Living Building." 2025. KPFF. January 22, 2025. https://www.kpff.com/project/pae-living-building-kpff/.

"The Design." 2025. Theodore Roosevelt Presidential Library. https://www.trlibrary.com/project/design.

"The Red List." International Living Future Institute. https://living-future.org/red-list/.living future. 2025.

"The World's Largest Urban Commercial Living Building | PAE Living Building." n.d. PAE. 2026. https://www.pae-engineers.com/about/pae-living-building.

"Architects tend to be perfectionists, but buildings are messy…"

- P.J Melton (BuildingGreen)

Georgia Institute of Technology