Next-Use Architecture: Durability, Serviceability, Adaptability

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THE CASE OF ROME

Rome, for one example, has some of the most sustainable buildings in the world. This is not on account of an array of exuberant, high-tech, high-performance buildings but rather a pervasive and persistent practice of durability and re-use. A simple but poignant criterion for sustainable buildings is a measure of its total energy (embodied + operational energy) divided by the number of occupants and users that those resources serve over time. In Rome, the ecological, economic, social, and cultural amortization of its low-embodied energy and low-operational energy of its building stock divided by the generations it has served through the millennia strikes a sharp contrast with a contemporary, high-tech, high-performance building that will serve a limited population for fifty to a hundred years. This criterion emphasizes the importance of durability and adaptability as primary determinants of long term sustainability.

Sustainability is fundamentally a sport of resources. In respect of the utilization of these resources, the familiar triad of reduce, reuse, and recycle has an implied hierarchy. Reducing or eliminating consumption is optimal. In architecture, a radically smaller building, or no building at all, is often the optimal solution in this respect. Recycling, the most common but least effective strategy, in many cases merely excuses more consumption and more energy for reprocessing, re-transportation, and reinstallation.[1] Recycling often follows a logic of negated efficiencies: new construction may be slightly more efficient but there is more and more of it that negates its gains in efficiency.[2] Reuse, closely related concept of next-use, is the most reflexive mode for architects and yields great efficacy for the profession.

Whereas re-use involves the reclamation and repurposing of existing resources and buildings, next-use points towards a more active evaluation of existing conditions with present and future uses in mind for existing and new construction. While the re-use of existing resources is no doubt wise, innovative energy strategies for present and future uses along with adaptable planning strategies are necessary for long term sustainability. Next-use requires the novel thermodynamic imagination of the existing conditions and resources, the strategic amplification of existing physical and cultural amenities, the integration of new and archaic modes of construction and energy systems, and rich, if not restrained, interventions in the built environment to achieve purposeful and sustainable buildings that will continue to serve multiple generations through next-uses. Building strategies based upon massive, low-embodied energy systems, robust structural systems, thermally active surfaces, serviceable and maintainable material systems, and spatial planning that is not overly specific all stand to amend the trajectory of sustainability in the United States.

SPECIFICALLY GENERIC

Adaptability is often antithetical to the overly specific preoccupations of many architects, programs, and building types. Spatial planning and material specifications that anticipate change are necessary however for durability. A slightly looser fit between program, infrastructure, and energy strategy is advantageous to next-uses. The Salk Institute for Biological Studies is an excellent example of a building that was designed to be continuously adapted as the demands of science change.[3] In terms of planning and infrastructure, the building is specifically generic. That is, its spatial, material, and energy systems were specifically designed so as to be easily altered. This is especially evident in the spaces that serve the laboratories. In the programming stage, Dr. Salk referred to these spaces as a "mesenchyme space." Mesenchyme is the portion of an embryo containing non-specific cells that develop into other tissue and organ systems. In other words, mesenchyme tissue is specifically generic; its open-ended qualities and properties engender multiple possibilities. In this building, this adaptable planning is fundamental to the research and economic vitality of the institution, its raison d'être. This adaptability applies to material systems as well as the building's spatial planning. The Salk Institute for Biological Studies has two architectures. One is the robust concrete frame and the other is the light weight oak, teak, A242 steel, and glass surfaces that enclose openings in the concrete frame. The concrete system is the robust, perdurable armature that absorbs the ceaseless change of its other, more adaptable counterparts. This presents a highly flexible strategy when combined with its uncompromised approach to programmatic and infrastructural flexibility. In this century, there will be those buildings that anticipate change and those that do not. The former is the most sustainable in most cases.

DURABILITY

Durability is fundamental issue in the American path of sustainability in the United States. While overly specific spatial and infrastructure planning of negate possibilities of adaptation, current material and energy strategies also limit next-uses. The tendency in current practice is to add another thin layer or system for every issue that emerges in an increasingly complex context of design and construction. This is dubious expenditure of resources in respect of durability and makes practice more complex. While information management systems such building information modeling may us cope with this complexity, it will not alone reduce any level of complexity. A promising direction is for more well-integrated design that collapses several material and energy systems into a single system. The aim is to lower the embodied and operational energy of a project with fundamentally durable material systems while also simplifying practice through fewer yet more robust systems and defragmenting construction. Central to this approach are thermally active surfaces that merge the structural, thermal, insulation, and finish materials of a building into a single material system and surface. This gives the architect and architecture a new and more poignant role. The expansion of a sensibility driven by durability in the United States will inevitably involve significant changes. In the long view, however, the advantages of material and labor systems directed toward robust material and energy systems are substantial. Finally, research for material energy systems that apply equally in developed and developing countries point towards other, necessary, forms of sustainability.[4]

NEXT USE CASE STUDIES

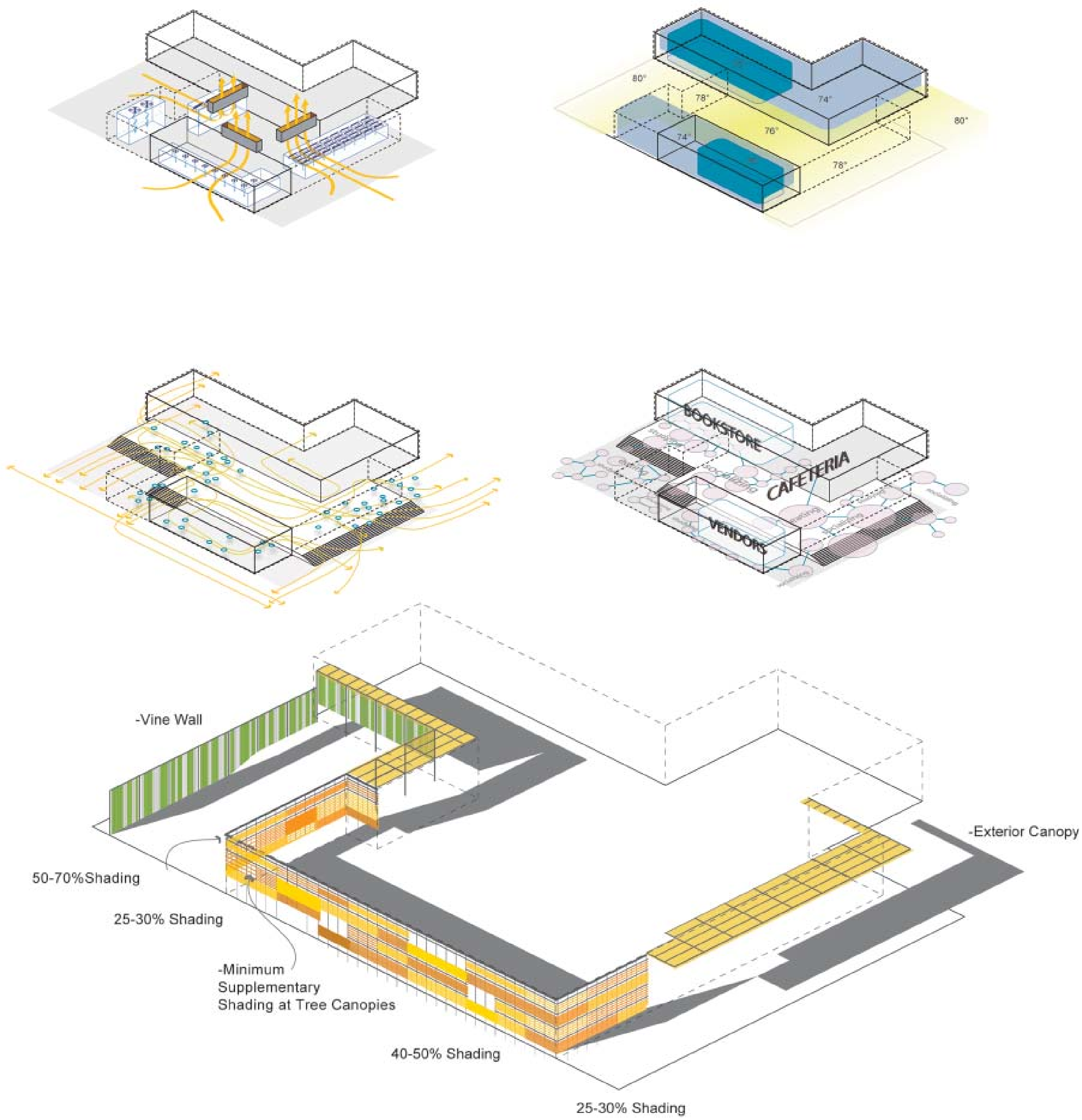
The following case studies point towards a design sensibility that seeks novelty within the thermodynamic resources of prior, current and future uses. In each case, the projects redeploy the embodied, operational, cultural, and historical energy of existing buildings to accommodate next uses. While the adaptive re-use of the existing building is a major, if not the most obvious, aspect of next-use architecture, the focus here is on projects whose thermodynamic strategies exceed mere re-occupation.

LAVIN-BERNICK CENTER FOR UNIVERSITY LIFE

New Orleans, LA
VJAA

The 150,000 square foot Lavin-Bernick Center for University Life on the Tulane University campus reuses an existing concrete-framed student center that was designed as a hermetically sealed box, controlled entirely by power-operated systems. Throughout the project, there is persistent effort to make a more spatially, programmatically, and environmentally porous building that meshes better with current needs and uses. In doing so, the project maximizes its engagement with its existing conditions—that of the existing building but also the climatic and historical conditions of New Orleans.

Familiarity with the climatic adaptations of vernacular buildings in this region triggered novel energy strategies for the reuse of the existing building. For example, shaded porches, louvered solar control devices, and paddle fans we all updated from vernacular antecedents for use in this project. Such devices amplify not only the thermodynamic strategies of the project but the social ambitions of the proj-



ect. They provide mutable spaces in and around the building where air, light, and people are mixed. This expands the definition of the building boundary. Like vernacular solar control systems, much of the building is layered with louvered solar control system or a vegetated wall to modulate daylight and solar heat gain. Here, the spacing and chroma of the louvers varies around the building according to its solar exposure and the program contained beyond. A number of other, more contemporary, thermodynamic strategies were used in the reuse of the building.

A central atrium features a set of water walls. Initially counter-intuitive, the addition of water in the space helps de-humidify the space. The water that sheets down the polycarbonate surface is at a temperature lower than the dew point of the atrium. Thus, air adjacent to the water surface condenses on the surface and thus lowers the latent heat of the space while removing the humidity in the form of condensate. A set of large paddle fans direct atrium towards the water walls. On the other side of the water walls, one of there major clerestory light and air stacks rise above the roof plane. The surfaces of the monitors are designed to absorb heat to help exaggerate the buoyancy of exhaust air in the surrounding space while also admitting daylight into the depth of the deep floor plate. A smaller paddle fan push conditioned air back to the occupied zone above the floor and induces turbulence that have physically and perceptually advantageous cooling effects.

A perforated metal skin unifies the ceiling of new and old portions of the construction. While this treatment remains visually similar, the function it performs varies throughout the project. In certain areas, the perforated metal helps diffuse day light. In others, it is a thermally active surfaces that uses a hydronic system for radiant cooling, or radiantly absorptive surface, lowering the operative temperature of the space. Throughout the project, the perforated metal ceiling aids in the acoustic control of the otherwise open and acoustically live surface treatments in the project.

Central to the programmatic and thermodynamic reconfiguration of this project is the concept of zoning. According to use, certain zones are more open and porous (such reading areas and atria) while others are more closed and contained (such as auditoriums). The programmatic and air zones of the buildings were overtly conceptualized and designed in tandem. This minimizes the required areas for fully air-conditioned spaces and results in more discrete control systems mechanical plant size.

In anticipation of unknown future uses, program, spatial planning and material systems were conceived together. Program uses with higher turnover such as retail were arranged together and program with more enduring functions such as the auditorium received more enduring material systems. When viewed as an example of next-use, this project is best understood as a set of gradients: programmatic, spatial, air, and light gradients but also gradients of past, present and future uses.

PITTSBURGH GLASS CENTER

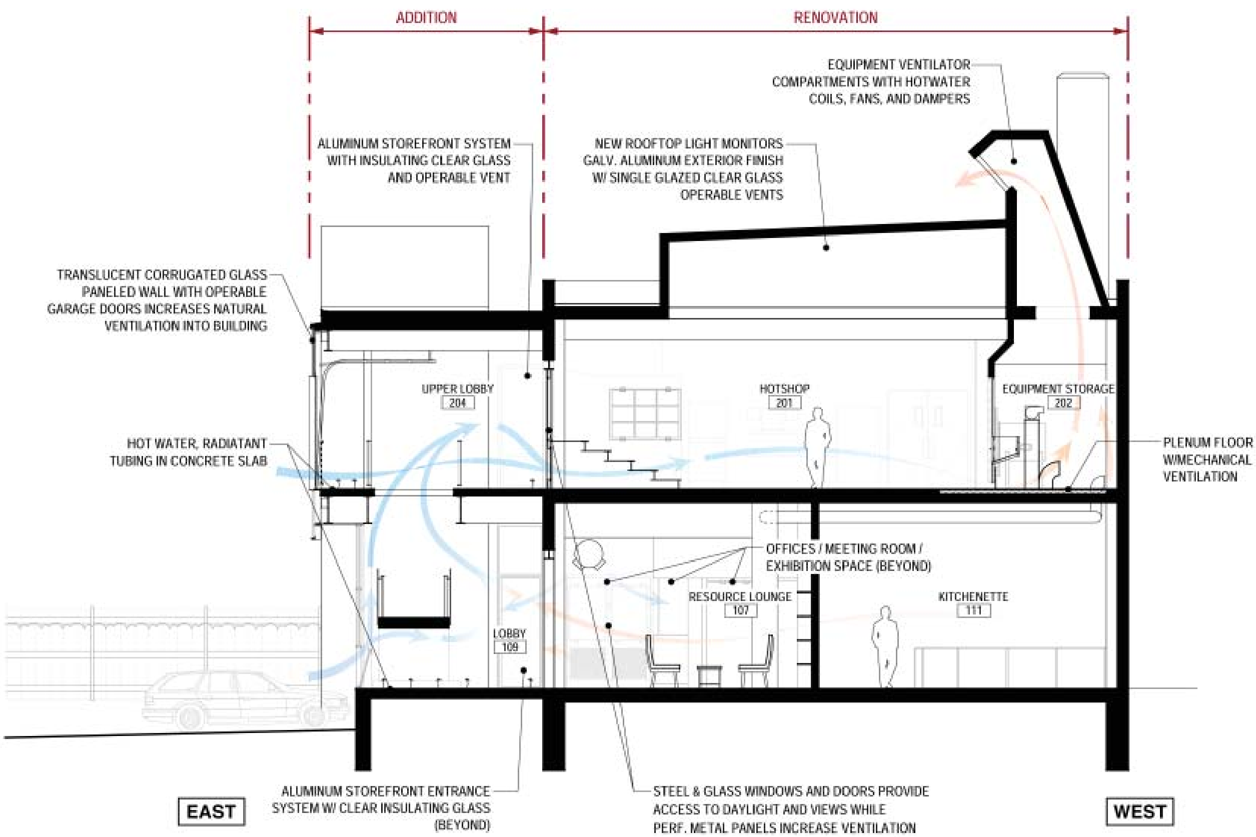
Pittsburg, PA
DGGP Architects

The 18,000 square foot Pittsburgh Glass Center is a community glass art education facility. The project consists of an existing masonry building—that formerly served food, mattress and automotive retail functions—and the addition of a steel and glass entry and circulation bar. The energy and material inherent in the exiting building and the proposed program are creatively and thoroughly maximized in order to minimize the project's embodied and operational energy. In this case, there are economic benefits for the operating budget of this non-profit entity as well as ecological benefits.

Separating building circulation into the new bar consolidates new circulation and code requirements in new construction while opening the floor plates of the existing building for programmatic use and ultimate future flexibility. To follow through with this approach to adaptability, the infrastructure and material systems of the project utilize an aesthetic and service strategy of exposed systems. The access to the infrastructure and open planning engenders a maintainable and adaptable building.

The corrugated glass cladding for the circulation bar was re-purposed from a field house at a Pittsburgh area university. The architects devised a system for dismantling the glazing and its aluminum mullions, packing and re-installing it in the new building. Here the de-installation design is as important the re-installation design. The glass material is an index of the arts program contains therein, serving as an emblematic entrance. The glaze circulation bar is a semi-conditioned space that can be closed off from the program areas. This bar is not just for the circulation of people: it also central to the circulation of light and air in this building.

It is important to grasp the integration of programmatic and building systems in this next-use project. The primary program in the project-glass arts studio space-is an inherently energy intensive program. Thermal energy is recovered from the furnaces in two ways. A thermally active floor absorbs heat that is transferred to the space below through unit heat exchangers. Secondly, another set of water-based heat recovery units in the flue above the furnaces capture and channel to air to air heat exchangers. Exhaust air form the studios and the office and gallery space below are channeled through the furnace flues. Supply ventilation emerges from operable openings on the first and second floor of the circulation bar. This circulation space tempers the outside air before entering programmed spaces. This space also has thermally active floors on each level that offset glazing loses and modulate the operative air temperature. As such the building is zoned as an atrium and the open program space are classified as open halls. This simplified the fire and smoke systems, allowing air to flow with substantial investments in fire damper systems and more substantial fire doors. The glass studio daylight monitors are also part of the air strategy. They evacuate buoyant exhaust air from the studio adjacent to the hotboxes. 82 percent of the building is lit with daylight. Other strategies include borrowed light from the circulation bar. Throughout the project, the mass of the existing masonry and the mass of the new concrete is used to delay the re-radiation of the glass studio heat until later in the night. In this project, many conventional HVAC logics and habits do not apply in favor of thermally active surfaces based upon



SECTION D-D

NOT TO SCALE

radiant transfer and natural ventilation induced by glass furnaces.

In summary, the next use of this building is characterized by the resourcefulness of the architects: an ambitious modesty that aimed to collapse material and energy systems for the embodied and operational economies for the non-profit client. Throughout, the designers courted the ecological and economic advantages of thermally active surfaces, the thermodynamics of the existing and program conditions, and the existing material resources on and off the site. The result is a thoughtful sparseness that openly receives its program and anticipates future uses.

THE LOVEJOY BUILDING

Portland, OR
OPSIS Architects

This next-use project is a prime example of designers anticipating future uses as they develop present uses. The existing conditions include a 1910 masonry building that was once a horse stable and is adjacent to public transportation. The current use includes space for an apparel company on the lower level and the offices of the renovation's architect on the upper level. In multiple ways, future uses and expansions were anticipated in the design of the present use.

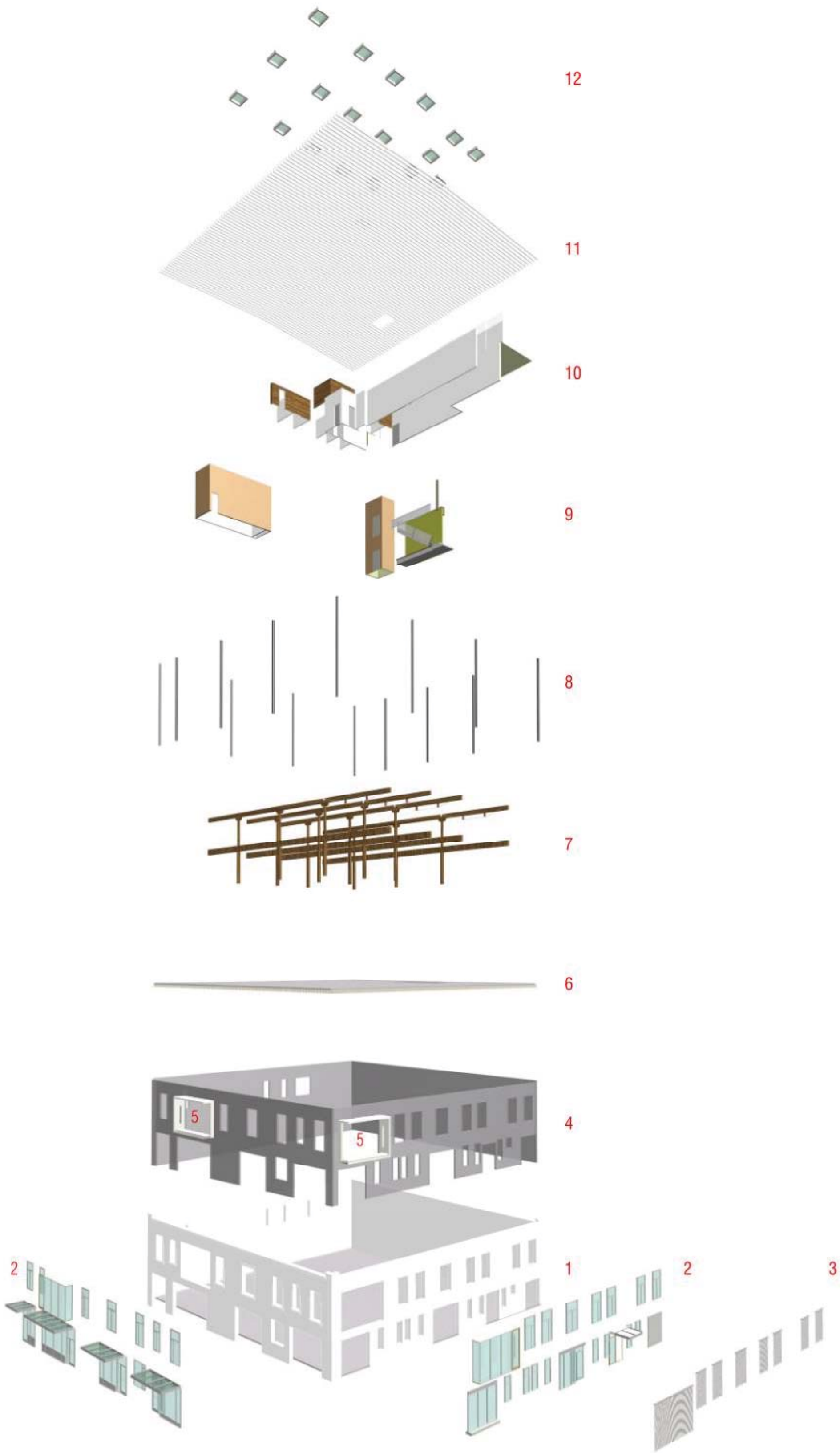
The re-use of the existing masonry shell required seismic upgrades to meet current codes. The architects designed a new concrete wall inside the masonry shell and a new concrete floor as a more robust diaphragm. This greatly extends the life of the original shell and structure. The new concrete wall is anchored to the masonry shell and occasionally pokes out of the masonry shell as new occupiable box window bays. The concrete floor diaphragm was also used as a thermally active surface to heat and help cool the spaces. In the summer, the floor slab and a night purge ventilation strategy satisfy the thermal needs in temperate Portland. For cooling, the floor slab is a radiant absorber. The heat collected by the slab is then run through a rooftop chiller, releasing its heat in doing so, before looping back through the slab. For heating, the slab acts as familiar hydronic radiant slab. To decrease cooling loads, daylighting was improved by increasing the size of the window apertures along with an unobtrusive, automated solar shading system on the exterior of the glazing.

The conservation of material resources on the site is very evident here. Bricks removed from the enlargement of the windows in the masonry shell became a porous paving strategy in the limited car parking for the project. Cut-off materials from a new bamboo floor, other wise waste scrap, were used from hand rail material. Removed ceiling joists were milled down to become tread material for treads on a new stair.

The renovation anticipates future uses and additions. While designing the renovation of the two storey building, the architects simultaneously designed a scheme for a two story above the renovated building. Integrated solutions abound. The steel structure for the addition is coordinated with skylight locations in the current renovation, therefore minimizing disruption to the existing constructions. The skylights will then be transferred to the roof of the addition. The new concrete wall for the seismic upgrade was sized to accept the bearing of additional loads from the two storey addition. The present stair location will become a circulation core through the whole building, enabling additional buoyant air strategies.

Throughout this project, the architects persistently rehearse future uses as they design current uses. To do so, they also look to maximize the resources available of the given site: climate, transportation, and material resources.

1. existing exterior brick shell; punched openings enlarged for enhanced daylighting and natural ventilation
2. digitally automated awning and casement windows w/ high performance glazing tied to CO_2 sensors
3. west facing digitally automated exterior fabric shades with manual override
4. interior concrete shell liner added for shear resistance and radiant building mass
5. full height cantilevered concrete oriels w/ slider doors and guardrails
6. level 2 hydronic radiant / chilled floor slab
7. existing timber post and beam structure
8. steel columns imbeded in interior concrete shell liner for future 2-story expansion
9. vertical stair and elevator cores with bamboo plywood finish
10. interior partitions
11. existing wood ceiling joists and deck painted white for enhanced light reflectivity
12. digitally automated skylights tied to CO_2 sensors for enhanced daylighting and natural ventilation



CONCLUSION

In each of these projects, not only is the energy embedded in the existing building maintained as a resource, but new thermodynamic strategies amplify the existing conditions. This advances the efficacy of the present use and serves as models for next-use strategies. While the re-use of existing buildings is highly supportable, these projects re-imagine the thermodynamic potential of the building s while anticipating future uses, pointing towards a sensibility of next-use architecture.

ENDNOTES

1. John Tierney, "Recycling is Garbage" New York Times, 30 June, 1996. initially opposing positions on the issues now agree on this contested issue, both the Worldwatch Institute and Bjorn Lomberg have stated that the actual merits of recycling are in doubt: "ultimately, recycling simply results in the manufacture of more things." Worldwatch Institute, Good Stuff? A Behind-the-Scenes Guide to the Things We Buy, p 1. from Worldwatch Institute, State of the World 2004 (New York: W.W. Norton & Co., 2004). Lomberg: "…the current recycling level is reasonable, but that we perhaps should not aim to recycle much more." Bjorn Lomberg, The Skeptical Environmentalist. (Cambridge: Cambridge University Press, 2001). P 209.

2. Michelle Addington, 'Energy, Body, and Building.' Harvard Design Magazine. Number 18 (Spring/Summer 2003): p. 18-21.

3. For further discussion on the Salk Institute for Biological Studies on this topic see "Extra Ordinary Performances at the Salk Institute for Biological Studies" Journal of Architectural Education 'Performance Architectures' theme issue, vol. 61, issue 4. May 2008.

4. This is consistent with E.F. Schumacher's notion of intermediate technology. E. F. Schumacher. Small is Beautiful: Economics as if People Mattered. (New York: Harper Perennial, 1989.) p. 181-200