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## The Machine as the Garden

*The New Harvard Campus in Allston, Sustainability, and Its Effects on Design*  
by **Nathalie Beauvais**

If the beginning of Harvard's large fifty-year campus development across the Charles River in Allston is any indication of what future design and planning hold in store, we are entering an era in which building and landscape *performance* to minimize negative effects of the built world on nature will take a leading role. This means that technical and engineering considerations will assume new prominence, that teams of designers and scientists will need to collaborate constantly from early on, and that efforts to make buildings and landscapes *aesthetically* strong will need to seamlessly integrate environment-supporting features. And that in turn means that the new Harvard will not and should not look like the old Harvard. If the Allston campus were to be made of brick buildings on expanses of treed lawns, Harvard would be shirking its responsibility to and leadership of the wider world.

The old cliché that the pursuit of

greenness in buildings is inevitably in conflict with the pursuit of aesthetic quality is disappearing fast. Green features are no longer being thought of as "tack-ons," like solar roof panels, but instead as elements as integral as support beams or doors. One must design *using* green features and making them as aesthetically rich and appealing as any other aspect of buildings. The goal of sustainability integrates professions because it forces comprehensiveness and interconnection in addressing all elements of the project: infrastructure, architecture, landscape, and place-making. Only sophisticated engineering and technology can mitigate the impact of development. We must begin to think not of Leo Marx's "machine in the garden"<sup>1</sup> but of the machine as the garden. Acknowledging the engineered nature of the built habitat is a necessary step for embracing sustainable design at the campus scale.

# On Sustainability and Design

In January 2007, Harvard released a draft plan for Harvard in Allston,<sup>2</sup> the beginning of the largest planning effort in the University's 372-year history. Harvard has set an ambitious goal of sustainable development for the 200 acres and nine to ten million square feet of buildings. The plan presents an ideal(ized) vision of how development will transform industrial land into a vibrant, picturesque campus. While it provides a necessary first step in pretty imaging, in reconciling the many stakeholders' aspirations, and in proceeding through the regulatory process, it will soon give way to a detailed framework that will integrate the requirements of infrastructure, utilities, and technology. The University is already proceeding with the design and construction of a *Science Complex* of half a million square feet that provides a first challenge for comprehensive sustainable development.

The making of the Harvard Allston *Science Complex* is an exercise in "integrated design."<sup>3</sup> The project's commitment to sustainability mandates a comprehensive approach to design advocated by Behnisch Architekten, its designers. Climate engineers strategize the energy performance of the whole and are necessarily informed by HVAC engineers and lighting consultants. Civil engineers work with the utility team and landscape architects to develop storm-water management plans and then coordinate with structural engineers for assessing the weight loads of plantings, proper soil attributes, and means of storing water. Such collaboration is not entirely new, but what is different in thorough sustainable design is the level of coordination required and the iterative process for maximizing each of the building systems and the site design.

The sustainable development of Allston is part of a global trend. A few ambitious projects provide models: Foster is part of a team<sup>4</sup> designing a carbon-neutral, zero-waste community in the United Arab Emirates.<sup>5</sup> Columbia University is expanding its campus in Manhattanville as a pilot project for the new LEED Neighborhood Design program.<sup>6</sup> In Dogtan, China, guidelines are being es-

tablished for the development of a sustainable community of half a million.<sup>7</sup> The performance targets address resource efficiency and can be read like source code for a computer operating system — the performance criteria will direct the *forms* of the built environment.<sup>8</sup>

Performance requirements are also impacting design in Allston. For example, energy goals led to a certain selection of building materials and assembly of building parts. For the Allston *Science Complex*, traditional brick walls, because of their inability to perform like a breathing skin, were early seen to be incompatible with sustainability, and this rapidly concluded years of debate about whether the new buildings should replicate (as *many* hoped) Harvard's neo-Georgian architecture. The facades of the *Complex* adapt to specific conditions: solar orientation, landscape design, buildings' proximity and massing, and performance requirements. The facade grid is modified and varied for lighting, views from within, and thermal requirements. The building skin system has movable parts for ventilation and sun-shading; light shelves direct light deep into laboratory spaces. Such responses to standards limiting demand on water and energy have been embraced and constantly updated in Europe. And in fact the *Science Complex* will be incorporating construction methodologies popular in Europe.

Sustainable design transforms architectural and planning projects into measurable scientific experiments. The achievements of the *Complex* and of the Allston campus will be assessed in terms of released metric tons of carbon dioxide equivalents, greenhouse gases, and total suspended solids of storm water. Aesthetic efforts will have to subsume these ecological efforts. As is demonstrated by the programming of the *Complex* and the development of a draft utilities master plan for Allston, sophisticated new science buildings have huge demands for services as defined by material handling, parking, and specialized resources. Recycling policies add to the space requirements

for material sorting and storage. Understanding and designing servicing and utility systems are fundamental to understanding how infrastructural needs can preclude certain architecture and landscape architecture design moves.

Mechanical penthouses for the *Complex* could make up as much as one-third of the buildings' volume. The needs for underground infrastructure are as demanding. Almost the entire ground surface sits on a structure providing a parking garage, loading facilities, distributed energy facilities, and shared science resources. Even though 50% of the site is open space, in the Harvard campus tradition, it will be a highly engineered landscape. The main challenge resides in the successful integration of the many building systems, the underground services, the roof, and all in between.

One key step in the campus development is providing sustainable infrastructure and utility systems. For example, siting geothermal wells and ground-source heat pumps (which use the earth as either a pre-heat source, when operating in heating mode, or a heat sink, when operating in cooling mode) will require the allocation of land that will impact building and site design. Another example in utility planning is water management with the goal of improving runoff water quality and protecting the Charles River. Comprehensive measures are being adopted to reduce the volume and flow of storm water discharges into the river, to treat storm water runoff, and to meet at least 50% of water demand for buildings and site elements using non-potable water, like landscape irrigation, with locally recycled water. All these require space for treatment and storage facilities. Consequently, about one-third of the *Complex's* open space is dedicated to water management; this creates a "working landscape." Steve Stimson and Associates, landscape architects, initially received conflicting directions to investigate Harvard Yard as an aesthetic model *and* to implement sustainable water management features like bioswales (designed to remove silt and pollution from sur-

face runoff water), rain gardens (planted depressions designed to absorb runoff), and drought-resistant native plants — all of which would preclude a Harvard Yard look.

In “Terra Fluxus,” James Corner notes that “in the opening year of the 21st century that seemingly old-fashioned term *landscape* has curiously come back into vogue. The reappearance of landscape in the larger cultural imagination is due, in part, to the remarkable rise of environmentalism and a global ecological awareness, to the growth of tourism and the associate needs of regions to retain a sense of unique identity, and to the impacts upon rural areas by massive urban growth.”<sup>9</sup> As is demonstrated in Harvard’s planning for Allston, this renewed focus on landscape might generate misconceptions about what urban environmental landscapes can and should be. While there has been much debate about modern versus traditional architecture at Harvard, little has been said about the changing character of landscape. Traditionalists expect that the Allston campus landscape design will provide a continuous ground uniting the parts of the extended campus in a dominant simple open space. But that ground will need to be broken into working landscapes and recreational or ceremonial landscapes. A lawn in the tradition of Harvard Yard *is* planned, but it becomes something exceptional among rain gardens, bioswales, and retention ponds.

Because the Allston project is so large, it also entails urban design, and this must manage storm water on streets and sidewalks. The Allston Development Group, the Harvard organization responsible for implementing the campus plans, is building a pilot project to investigate how to integrate water retention basins and rain gardens into sidewalks.

The goal of the Allston plan is not to produce self-sufficient buildings that would use only resources available on site — this would be unrealistic considering the urban context and energy needs for science research — but to limit demand on water and energy by all

means possible.

“No Building Is an Island” is the title of a recent *Harvard Design Magazine* article on urban ecology by Yale professor Michelle Addington. “In cities, multiple systems at multiple scales are overlaid, and the interrelationship between buildings, as well as between buildings and infrastructures, introduces several confounding variables. The contradictions that arise from this complexity call for difficult choices.”<sup>10</sup> Addington is focusing on building energy and demonstrates the need to look beyond the building’s limited boundaries to its immediate surroundings (e.g., its potential increasing of the “heat island effect”) as well as its relationships to global, national, and regional energy production and use.

Harvard is aiming for new buildings in Allston to be LEED certified at the Gold level.<sup>11</sup> This plus meeting the University’s sustainability guidelines for Allston for energy performance will provide reductions in greenhouse gas emissions of 40% to 60% compared with conventional development. The *Science Complex* will be the first building in the master plan to pursue LEED Gold. As part of the regulatory review of the *Complex* by the Massachusetts Environmental Policy Act Office, the University voluntarily committed to designing the *Complex* in a way that will produce 50% less greenhouse gas than a typical lab building designed to American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) standards. To meet this commitment, the first science complex includes solar panels, geothermal wells, cogeneration (the useful employment of heat generated in the making of electricity), earth ducts (through which fresh air is drawn to pre-cool it in summer), internal heat shift chillers to maximize thermal energy distribution, and control systems for energy efficiency and peak load reduction.

To achieve this ambitious energy-efficiency goal for lab buildings means that many standards have to be challenged or revisited. For example, ASHRAE standards require that there be air renewal in lab buildings at least six to ten times

per hour. But the cooling needs resulting from heat-producing laboratory equipment drive air-exchange needs to as high as fifteen to twenty times per hour. Complying with these standards results in very high energy demands.<sup>12</sup>

Acknowledging that the ASHRAE standard was established for specific conditions, the criterion can be fulfilled in specific zones and not in the entire ensemble of the lab building. Terminal units to regulate air flow to a room or group of rooms allow shifting energy between zones in response to demand and provide significant savings.

Hybrid cooling towers are being considered for the *Science Complex* to reduce demand for water. Traditional cooling towers expose water directly to the air, creating a visible plume of water vapor and requiring replacement water. Hybrids keep the cooling water contained and use additional water only during hot periods, thus greatly reducing water use. Hybrids also produce less noise. The drawbacks of using hybrids are that they are larger than conventional cooling towers and, in the case of the *Science Complex*, can increase penthouse height by as much as 20%.

For each element of the project being challenged, standards, protocols, and requirements have to be reviewed by a team of professionals that has to embrace sustainability.

The integration of many disciplines, scales, and phases of development has been extensively covered in recent literature. Alan Jacobs wrote that effective city planning must work simultaneously at three spatial scales — the city, the neighborhood, and the individual project — and at three temporal scales — longer than four years, one to four years, and within one year.<sup>13</sup> In this magazine, Alex Krieger wrote of gaining “insights from other scales,” and Michelle Addington wrote that “multiple systems at multiple scales are overlaid” in the design and construction of buildings and the making of cities.<sup>14</sup> The challenge for design and planning professionals is to define who in collaborating teams should take the lead and

how efforts should be integrated on a project-specific basis. Rem Koolhaas has written that “whenever there is a revolution, or fast change, in architecture, professional barriers break down as specialists exchange roles. Architects become sculptors, engineers become designers, artists turn into architects, and all these job descriptions become fuzzy.”<sup>15</sup> Arup Consulting Engineers, Designers, Planners, and Project Managers have recently created a “Planning and Integrated Urbanism” team that pulls expertise from every corner of the firm.<sup>16</sup> The goal is to “help design cities that work better — not just as grids or transport networks or skylines, but as ecosystems engineered from the start to foil gridlock, energy waste, pollution, even economic inequality, and not have specialists focusing on a contained specialization, e.g., water management or transportation.”<sup>17</sup> In *Some Assembly Required*, Michael Sorkin argues for a reunion of architecture and urbanism both to meet their global and local responsibilities and to fulfill their promise of joy.<sup>18</sup> Landscape architecture and engineering should be added to his list. Sorkin’s statement is idealistic, but ultimately nothing less should drive the making of cities and campuses. □

## NOTES

1. Leo Marx, *The Machine in the Garden: Technology and the Pastoral Ideal in America* (New York: Oxford University Press, 1964).
2. The Executive Summary for Allston framework was produced for Harvard University Allston Development Group by Cooper Robertson and Partners and can be viewed at <[www.allston.harvard.edu/imp/IMP\\_Exec\\_Summary\\_010907.pdf](http://www.allston.harvard.edu/imp/IMP_Exec_Summary_010907.pdf)>.
3. See Jonathan Ross, “Come Together: Integrating Design,” *Harvard Design Magazine* 27, Fall 2007 / Winter 2008.
4. Transsolar, Climate Engineers, is part of the Foster team and also a member of the Behnisch team for the Allston Science Complex.
5. <[www.fosterandpartners.com/Projects/1515/Default.aspx](http://www.fosterandpartners.com/Projects/1515/Default.aspx)>.
6. Columbia Manhattanville project can be viewed at <[www.columbia.edu/cu/neighbors/pages/manplanning/proposed\\_plan/environmental.html](http://www.columbia.edu/cu/neighbors/pages/manplanning/proposed_plan/environmental.html)> and information on the “Pilot Version of LEED Neighborhood Development Rating System,” USGBC, 2007, can be

found at <[www.usgbc.org/ShowFile.aspx](http://www.usgbc.org/ShowFile.aspx)>.

7. Dongtan was presented at the United Nations World Urban Forum by China as an example of an eco-city and is the first of up to four such cities to be designed and built in China by Arup. However, the planned ecological footprint for each citizen in Dongtan is 2.2 hectares, higher than the 1.9 hectares that the World Wildlife Fund claims is sustainable. Source: <[http://en.wikipedia.org/wiki/Dongtan\\_Ecocity](http://en.wikipedia.org/wiki/Dongtan_Ecocity)>.
8. See Douglas McGray, “Pop-up Cities,” *Wired*, May 2007, 161 – 185.
9. James Corner, “Terra Fluxus,” in *The Landscape Urbanism Reader*, ed. by Charles Waldheim (New York: Princeton Architectural Press, 2006).
10. Michelle Addington, “No Building Is an Island,” *Harvard Design Magazine* 26, Spring / Summer 2007, 38 – 45.
11. LEED (Leadership in Energy and Environmental Design) is a voluntary, consensus-based national rating system for developing high-performance, sustainable buildings. Developed by the U.S. Green Building Council, LEED addresses all building types and emphasizes state-of-the-art strategies for sustainable site development, water savings, energy efficiency, materials and resources selection, and indoor environmental quality. Source: <[www.usgbc.org/](http://www.usgbc.org/)>.
12. By referencing the latest codes for building construction, this air change rate has been proposed to be reduced to one cfm/sf.
13. Jacobs, Alan, “The State of City Planning Today and Its Relation to City Planning Education,” *Places* 18:2, June 2006, 60 – 65.
14. Alex Krieger, “What Can I Learn from You?” *Harvard Design Magazine* 27, Fall 2007 / Winter 2008, 81, and Michelle Addington, “No Building Is an Island,” *Harvard Design Magazine* 26, Spring / Summer 2007, 38.
15. See Rem Koolhaas’s preface to Cecil Balmond with Januzzi Smith, *Informal*, second edition (Munich: Prestel Publishing, 2007).
16. Source: <[www.arup.com/ourwork.cfm](http://www.arup.com/ourwork.cfm)>.
17. McGray, 161 – 185.
18. Michael Sorkin, *Some Assembly Required* (Minneapolis: University of Minnesota Press, 2001), xi.