GREEN ROOFS EXPAND MINDS AND OPPORTUNITIES

By Gary Brock

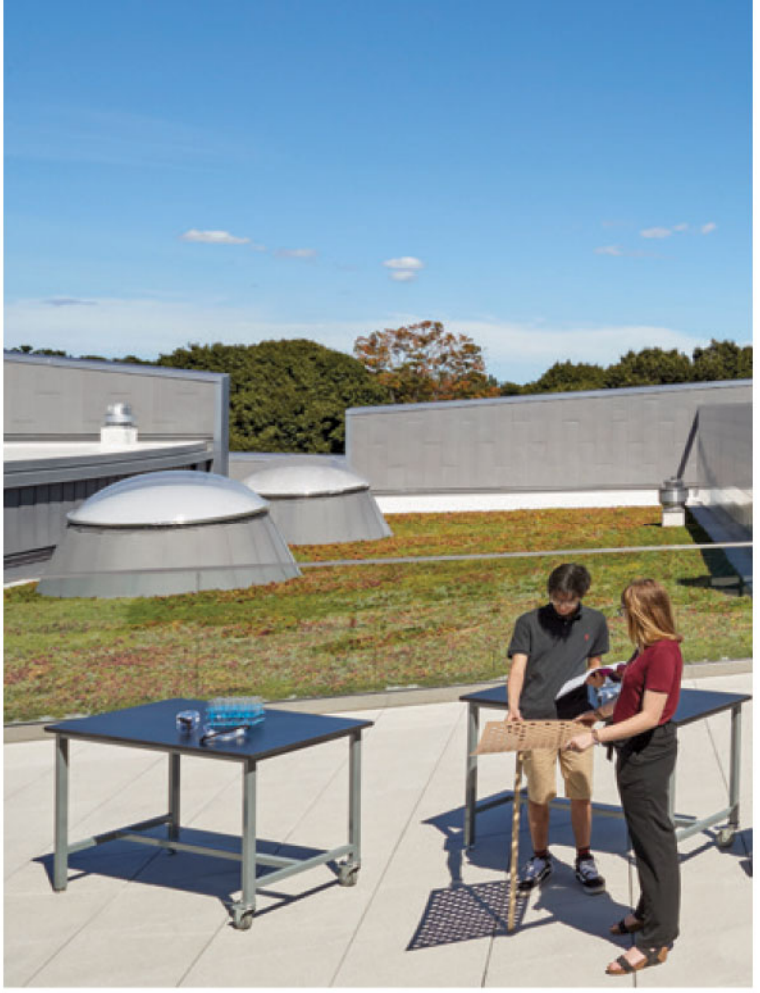
GREEN ROOFS ARE NOT NEW: The Hanging Gardens of Babylon (c. 500 B.C.) were one of the Seven Wonders of the Ancient World and an early version of a green roof, with gardens cascading over stone pillars and roofs waterproofed with tar and reeds. Green, or sod, roofs have been around for centuries—think "Vikings" in Scandinavia and the sod roofs of American settlers on the Great Plains. A precursor to the modern green roof was unveiled in 1867 at the World Expo in Paris featuring a waterproofing and drainage system. The 1920s and the 1930s yielded innovations by Le Corbusier, Alvar Aalto, and Frank Lloyd Wright. Their installation has increasingly expanded in Germany as practitioners improved the technology to use on existing and new buildings to proactively reduce stormwater runoff due to development.

Green Roofs for Healthy Cities defines a green roof system as an "extension of the existing roof which involves, at a minimum, high-quality waterproofing, root repellent system, drainage system, filter cloth, a lightweight growing medium, and plants." Basically, a roof that is covered or partially covered in plants.

Myths and Benefits

Common concerns about green roofs typically focus on integrity, maintenance, and cost. Although any type of roof can leak if not properly installed, green roofs installed by experienced contractors are much less likely to leak. While it is true that the first cost of a green roof installation, either for a new or existing building, can initially be higher than that of a typical single-ply membrane roof, the costs for a well-designed and site-appropriate green roof are often balanced by its long-term energy savings and the fact that the green roof will extend the life of the roof membrane.

Every green roof is unique, not only to the building and space it defines, but also to the local climate, and proposed use offering many benefits associated with such an installation. The most widely acknowledged ones are associated with environmental sustainability—specifically, stormwater management, water conservation, air quality, and mitigation of the heat island effect in dense urban settings. In addition to its benefit as an amenity, a green roof can also improve building performance through better mechanical performance and more efficient PV systems, as well as reduce acoustical transmission through roof assemblies.



The design of a green roof provides a blank canvas upon which to introduce biodiversity while contributing to the improved health and wellbeing of users. Many hospitals now include healing gardens on accessible, visible roofs because they can have such a positive impact on patient recovery. In the right setting, it can also serve as an effective educational tool, adding to its justification on new and existing school buildings.

Unique Schools, Unique Roofs

As a practitioner of sustainable design promoting the responsible use and conservation of natural resources, HMFH has had opportunities to leverage this expertise by helping three Massachusetts schools—Saugus Middle High School, Josiah Quincy Upper School, and Bristol County Agricultural High School—make smart decisions that reduced energy and water use and en-

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hanced learning while supporting the health and wellbeing of all users. Each school had different reasons for choosing green roofs.

Saugus Middle High School in Saugus, Mass., sited less than 300 feet from a busy six-lane highway, supports progressive education in grades 6 to 12 and celebrates the town's rich history of innovation. The $160.7-million school brings together 1,360 students in a 271,000-square-foot, STEAM-driven complex outfitted for exploratory learning and innovation.

Inspired by the Saugus River's fundamental role in the town's history, the new school incorporates multiple water conservation strategies. A stormwater collection and reuse system combined with the green roof slows stormwater runoff, saving more than 1.5 million gallons of water annually and leading to Saugus becoming the first project state-funded to reach the highest level of LEED certification, Platinum. In tandem with the environmental benefits, the 12,700-square-foot third-floor green roof provides program space for science curriculum-based learning, yoga, and mindfulness classes. The roofscape is centrally located and easily accessed by students and faculty. The exterior door to the outdoor classroom is also adjacent to the third-floor classroom devoted to medically fragile students, offering those with limited mobility more opportunity to be outdoors.

Currently under construction, the $146.8-million Josiah Quincy Upper School in Boston is a 175,000-square-foot, six-story facility that will accommodate 650 students in grades 6 through 12 when it opens for the 2024–2025 academic year. The location of the one-acre site, near the intersection of the Massachusetts Turnpike (I-90) and I-93, presented a different type of challenge than Saugus or Bristol Aggie. Combined, the two highways carry about 300,000 vehicles per weekday through the city, resulting in transportation-related air pollution.

During the design process, the project team and stakeholders placed a high priority on fitting a robust educational program on a small, urban site and creating spaces that advance health, wellbeing, and equity. Because no other outdoor space was possible on the site, a large portion of the roof will serve as an outdoor classroom and physical activity area featuring walking paths and native species gardens. An added benefit of the roof garden is the access to fresher air high above street level, while the plants also actively remove pollutants from the air. Based on the area of vegetation and native plantings, the green roof project will

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achieve a credit in LEED for restoring natural habitat. Planned PV canopies have been deleted due to budget constraints but are possible to add back if funds become available.

Located in Dighton, 45 miles south of Boston, Bristol County Agricultural High School is designed as a teaching tool: the campus is a classroom, the site is an arboretum, and sustainable design elements encourage important conversations about carbon and land use. A 50-percent increase in students required new construction, additions, and renovations to support greater collaboration and provide new state-of-the-art labs and specialized learning spaces.

The Center for Science and the Environment (CSE), a brick and metal-paneled structure on track to achieve LEED Gold certification, highlights the integral role of science and research in all Bristol Aggie programs. Functioning as a living learning center, the CSE supports a range of spaces including a student-curated natural resource museum, specialized bio-secure labs, flexible classrooms, and two different types of vegetative green roofs. The roofs are part of the core curriculum, providing student research opportunities on stormwater runoff, water conservation, biodiversity, and habitat preservation, and allowing student participation in green-roof installation and maintenance activities.

Ready, Set, Grow

While every green roof is unique to its intended purpose, size, local climate, budget, and maintenance constraints, successful installations are usually the product of an interdisciplinary team effort by an architect; structural, civil (for stormwater), and mechanical/electrical/plumbing engineers; landscape architect; botanist; and possibly irrigation specialist. State and municipal agencies can be important allies because of the overlapping trades involved and as more political advocates press for features such as this to increase climate resiliency.

Green roofs provide many benefits, from increasing a roof's lifespan, promoting biodiversity, and improving building energy performance to improving the efficiency of solar photovoltaic systems. While directly benefitting the school community, green roofs are also benefitting the broader community by cooling the immediate environment and reducing storm water runoff. Designing green roofs for schools offers even more opportunity: they can enhance the learning experience, improve health and wellness, and connect with a school's curriculum and program goals.

A champion for sustainable design, **Gary Brock, AIA, LEED AP BD+C,** is a senior associate and sustainability leader at HMFH Architects with over 30 years of experience. His practice focuses on learning environments that support student well-being and environmental stewardship. In his recent role as project architect for the LEED Platinum Saugus Middle High School, he integrated sustainability features such as a green roof classroom, on-site energy generation, and a stormwater reuse system into the design. Gary holds a bachelor's degree in environmental design from Texas A&M University and a Master of Architecture from the Boston Architectural College (BAC).