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New York City's Rodeph Sholom School was transformed by Ciro Cuono, P.E., LEED AP, of Hage Engineering, P.C., and Sara Grant, AIA, LEED AP, of Murphy Burnham Buttrick Architects.

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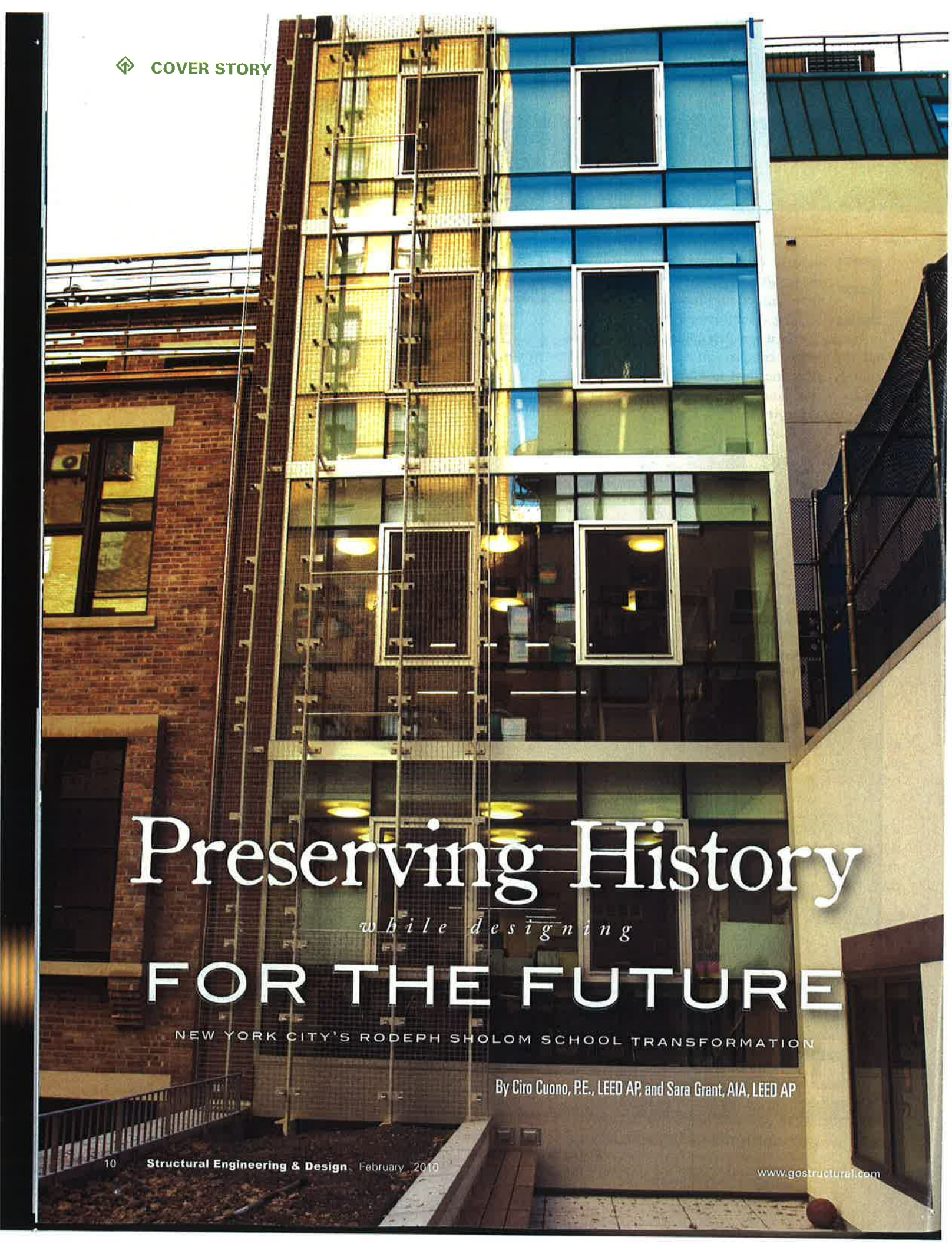

Preserving History

while designing

FOR THE FUTURE

NEW YORK CITY'S RODEPH SHOLOM SCHOOL TRANSFORMATION

By Ciro Cuono, P.E., LEED AP, and Sara Grant, AIA, LEED AP

A few years ago, administrators at The Rodeph Sholom School (RSS), an independent nursery through eighth grade school founded in 1958, were expecting a large second grade class for the fall of 2009. RSS quickly realized that they needed more classroom space, and fast! In addition, the school had a gymnasium that was only half the size desirable. At that time, the campus was located on Manhattan's Upper West Side and consisted of four landmarked brownstones built in 1910 that had been previously converted into a school. Comprised of several staircases and narrow passages, the existing spaces were cramped and labyrinthine in layout, and RSS desired more usable space for hands-on activities such as reading, teaching, and physical education. In 2008, the school had the opportunity to acquire a fifth brownstone adjacent to the existing school, measuring approximately 19 feet wide by 60 feet long. The design team went to work immediately to convert this residential building into the spaces the school so badly needed and expanded their campus to include more classroom space, an expanded gymnasium, and a new library.

Implementation of a sustainable design strategy was a high priority and sustainable elements are incorporated throughout the project to reduce long-term environmental impact and daily waste. The design team was able to help RSS incorporate these elements to serve a dual purpose, not only to ensure minimal impact on the environment, but also to serve as teaching opportunities woven into the school's curriculum whenever possible.

Landmarks Preservation Commission

Located in New York City's Central Park West Historic District, the existing townhouse was protected by the Landmarks Preservation Commission (LPC). In keeping with Landmark guidelines, the design team restored the front façade and retained the existing masonry party walls. Working closely with local community groups, neighbors, and the LPC, the team gained approval for the expansion of the building and for the modern rear façade that allows generous amounts of northern light into the new classrooms and library. A roof garden over the gymnasium and vertical green screen were proposed to offset the larger scale of the building and to contribute new green spaces to the neighborhood.

Architectural and structural design collaboration

Working within the constraints of the LPC, the design team worked closely together to create a facility that would satisfy all of the requirements of RSS. Many of the solutions called for detail-oriented, structural problem solving.

Left: The contemporary new window wall helps the narrow floor plate feel more expansive, while the green screen supports the project's sustainability goals. *Andrew Kist*

Right: The design was completed in five months and construction was completed in seven months, most while school was in session.

The Rodeph Sholom School Addition

Owner
Rodeph Sholom School/Congregation Rodeph Sholom, New York

Structural engineer
Hage Engineering, New York

Design architect
Murphy Burnham and Buttrick Architects, New York

Lighting design
Melanie Freundlich Lighting Design, New York

MEP engineers
Landmarks Facilities Group, Norwalk, Conn.

Geotechnical engineers
Langan Engineering, New York

Code consultant
Design 2147, New York

Contractor
Eurostruct, Inc., Brooklyn, N.Y.

Spotlight: Hage Engineering and Murphy Burnham Buttrick Architects

Andrew Kist

Ciro Cuono, P.E., LEED AP

Andrew Kist

Sara Grant, AIA, LEED AP

Q&A with the design team

Project Structural Engineer Ciro Cuono, P.E., LEED AP (CC), of Hage Engineering, P.C., and Project Architect Sara Grant, AIA, LEED AP (SG), of Murphy Burnham Buttrick Architects shared their thoughts about the Rodeph Sholom School project with **Structural Engineering & Design** Editor Jennifer Goupil, P.E. (JG).

JG: What was the most interesting thing about this project that inspired you during the design process?

CC: Coordinating the new design within the shell of the existing landmarked building and integrating that to the existing, functioning school. The existing walls…required some flexibility in the design so that field adjustments could be made.

SG: Working with a committed team to approach the numerous constraints on the project creatively to design engaging learning environments for children.

JG: What was the first task you needed to do to get started on the design?

CC: Determining how to restructure the existing brownstone to meet the elevations of the neighboring school and still respect the front façade and window layout.

SG: Resolving the building section was the first task. Given the misalignment of the school's existing floors and the existing punched windows in the landmarked façade, it was important to design a sectional strategy that maintained a connection to the outdoors.

JG: What types and how many structural systems did you and your team evaluate for this project?

CC: We evaluated five different types of framing systems for reframing the gravity system of the existing brownstone. This included engineering lumber, cold-formed steel joists, steel beams with metal deck, and concrete and variations in sizes, depths, and layout, for some. For the gym expansion we evaluated different truss configurations and long-span plate girders.

JG: What did you learn from evaluating different systems?

CC: During pre-construction, a separate contractor (Lehr Construction Corp.) assessed costs and constructability. Because of the constrained site, many of the cost savings came from a coordinated approach to simplifying on-site logistics rather than changes in building systems.

JG: How did you select the final structural system?

CC: The floor-to-floor heights were restricted, so selecting a thin structural sandwich was important. We also needed a system that could be threaded through constraints of the existing building in the least amount of space possible.

JG: How did you resolve the most challenging aspect of the structural design?

CC: The most challenging aspect was coordinating the full-story-high truss to fit within the existing wall. The existing gym roof framing had to be shored and reframed to the new truss chords with welded extensions.

JG: What was the most unique problem you solved on the project?

SG: The stepped seating areas and double-height space resolved the misalignment of the existing floors and windows by creating gathering areas in the classrooms and library.

JG: What lessons did you learn from this project that you will apply toward future projects?

SG: This project highlighted the need for early collaboration and tight coordination by the project team. Without this integration of architectural, structural, and mechanical systems, the generous spaces never could have been achieved on this constrained site.

JG: Did this project have owner-required sustainable design goals?

SG: The owner wanted to achieve LEED certification and wanted to provide a good indoor air quality for students and faculty. An energy model was completed to evaluate the energy efficiency of the selected enclosure, lighting, and mechanical systems.

JG: What sustainable aspects were pursued by the team?

SG: High-performance glazing was specified at the north facing window wall. Low- and where possible no-VOC finishes were selected throughout. Once [the next phase is completed and] the 6th floor is in place, the upper roof will be used for rainwater collection to irrigate the green screen and garden.

CC: Also, all hot-rolled and cold-formed steel shapes were required to contain recycled content such that post-consumer recycled content plus one half of pre-consumer recycled content was not less than 60 percent.

JG: What ideas did you implement to save project costs?

CC: Adding diagonals to the long-span truss we were able cut down steel weight. Also, by using a joist system we obviated the need for crane work.

SG: The design is open and efficient, minimizing construction. The finishes are durable yet simple and inexpensive. Standard furniture is used where possible instead of custom millwork.

JG: Is there anything you'd like to discuss?

CC: This project is in an urban setting, completely surrounded by other buildings, and construction had to take place in a functioning school. This created constraints at all areas of the building, which required us to document the existing conditions carefully and zero in on a workable solution early on in order to meet the tight schedule. The design processes followed these constraints and dictated some of the final details and solutions.

SG: The clarity of the design and the manner in which it addressed the client's needs helped generate the support of the community and the dedication of the design, engineering, and construction teams needed to complete the project successfully.

Interior framing — One situation the team faced was to marry the existing, historic façades with the interior program. To align with the floors of the existing school, the floor levels in the townhouse had to be changed. As a result, the new floors no longer aligned with the windows in the historic façade. The design team seized this opportunity to introduce stepped reading areas in the classrooms and a generous double-height gathering space in the new library. The structural team achieved this with a one-way, stepped concrete slab that spanned between new steel beams. The typical gravity framing consisted of 10-inch cold-formed steel joists at 16 inches on-center with a 1/2-inch-deep steel form deck and a 2-inch-deep concrete topping. The joists were pocketed into the existing brick walls at the new elevation and the old abandoned wood joist pockets were bricked solid to maintain the integrity of the walls.

Rear façade — In designing the new rear façade, the architectural and structural teams aimed to bring as much natural light as possible into the learning spaces. This called for a modern approach in place of the existing punched openings. The green screen was introduced to break down the scale of the new glass façade to relate to the surrounding landmarked buildings without mimicking them. The existing rear façade was demolished and replaced with a contemporary façade of aluminum and glass allowing natural air and light to flood the new classroom spaces. Ultimately, the punched openings in the new green screen mark the size and location of the original punched windows. The façade itself was created with a steel moment portal frame of wide flange members. The columns were set tight to the existing masonry walls and tied with epoxy anchors.

New classrooms — The most immediate need for RSS was to house the expanded second grade that was to occupy the building the following year. Therefore, achieving additional classroom space by the start of the school year was the school's highest priority. The aggressive construction schedule was designed to allow the school to operate safely throughout the 2008-2009 school year while providing the added space needed in time for the opening of school in September 2009. Achieving two classrooms per floor in a renovation that was limited to 19 feet wide required an efficient layout with no new circulation spaces. The classroom interiors were designed with the services spaces — such as bathrooms, storage, and teachers' desks — concentrated in the center so each classroom could take advantage of full access to the 19 foot width and to natural light through the exterior façade. The vertical circulation is entirely within the adjacent building.

New library — Previously, the school had a single library that the middle school and elementary school students shared. With the reorganization of the school and the creation of a new home for the elementary school, it was important to give the elementary school its own library and gathering space. The double-height space at the south end of

The school is scheduled to receive energy rebates of $40,000 through the New York State Energy Research and Development Authority for energy-saving measures incorporated into the project.

Firm Facts

Established in 1990 by Principal Mark Hage, P.E, this New York-based structural engineering firm employs 12 people and serves the residential, public, commercial, educational, and industrial markets. Areas of practice include renovations and rehabilitations, new construction, high-rise and special structures, historic structures, industrial and artwork design, forensic engineering, structural investigations, and analysis for sustainability upgrades. **Hage Engineering, P.C.**, received the Preservation League of New York State "Excellence in Historic Preservation" Award in 2009. Additionally, the firm was ranked first in the **Structural Engineer** Best Structural Engineering Firms To Work For Ranking in 2008.

Murphy Burnham and Buttrick Architects is headquartered in New York and was established in 1999. The office currently employs 15 people who practice within the areas of new construction, adaptive reuse, and interior design. Markets served by this firm, led by Partners Jeffrey Murphy and Mary Burnham, include educational, residential, and institutional sectors.

By the numbers: The Rodeph Sholom School Addition

Size, shape, and type

Number of square feet: 10,000

Number of stories: 5 stories plus basement and cellar

Structural system types: cold-formed steel joists bearing on existing masonry walls with metal deck and concrete topping; steel beams and metal deck with concrete topping; steel frames; steel Vierendeel truss.

Foundation type: spread footings on bedrock and grade beams

Construction quantities

Tons of structural steel:	36.5
Tons of rebar:	3
Cubic yards of concrete:	140
Square feet of deck:	6,700
Number of footings/piers:	6

Key products

- Hilti epoxy anchors for masonry and concrete substrates
- Bentley's STADD Pro was used for modeling, analysis, and steel design
- Enercalc software was used for framing and foundation design
- Exterior planted screen by Green Screen
- Water storage tank by Rainwater Hog
- Dual flush Flushometer by Sloan

Marrying the historic façade with the building's new purpose to establish the building's section proved to be most challenging on this project. *Murphy Burnham and Buttrick Architects*

the library has a stepped seating area that acts as a gathering space and anchor for the elementary school student body. A conference room with floor-to-ceiling glass overlooks the double-height space, visually expanding the volume of the space further. At the north end of the room, work tables are bathed in natural light from the new window wall. The librarian is positioned in the center to easily oversee the gathering space, work tables, and stacks.

Gymnasium expansion — Expanding the gymnasium, to almost double its size, as a single column-free space posed an entirely different kind of challenge. The wall that had to be demolished to make room for the expansion was a load-bearing wall, supporting the existing structure over the gym. The new rear wall of the building was to be supported on this existing bearing line. To address this intricacy, the architects and structural engineers worked together to create a one-story-high truss over the gym. This truss now lives in the wall between the new rooftop garden over the gymnasium addition and the existing corridor; see photo on page 11.

The structural team went to work expanding the east exterior wall of the existing school building to create a 50-foot span that would allow the new continuous space into the rear yard. This new space was then enclosed with steel framing and a composite, concrete and metal deck slab at the second floor level of the brownstone. The existing façade at the mezzanine, adjacent to the brownstone's yard, consisted almost entirely of windows between existing 8-foot-tall steel columns. A steel Vierendeel truss was determined to be the best solution to open the wall at the gym and maintain the existing fenestration. After shoring the existing gym mezzanine and roof framing, the existing wall was removed and the truss was installed. The mezzanine and roof framing were reframed to the new top and bottom truss chords with welded channel extensions. The truss vertical members were located at the same

spacing as the original columns so that the wall and window at the mezzanine were restored to their original look and feel. Because the first and last bays of the truss were solid panels with no windows, the structural team installed HSS diagonal bracing. This hybrid solution allowed greater efficiency with the chords and vertical members, and allowed for savings in steel weight.

The roof of the new gym includes a garden and green roof area with pavers and plantings. In addition to the environmental benefits, this created an interactive learning tool for the students who will be planting the garden and learning about how these spaces contribute to a healthier environment.

Sustainability

There was broad-based support within the school community to pursue LEED Certification for this project. To achieve this goal, the design team worked with teachers and school administrators to use the building elements to create learning opportunities. The project is currently pursuing a LEED Silver Certification. To support the LEED design, the stainless steel green screen was installed at the rear façade. This was designed to tap into a steel plate cantilevered off of the new rear façade beam. The green screen framing consisted of vertical bars, which support the screen for future plantings.

Some elements, such as dual-flush toilets, reduce daily waste and influence daily habits of the students and staff. Other efforts, such as the photovoltaic panels planned to be incorporated onto the roof in 2010, will actually be absorbed into the curriculum and serve not only as a contribution in renewable energy, but also as a platform for an education in sustainable design and how green systems work for the Rodeph Sholom School student body. ▼

Ciro Cuono, P.E., LEED AP, is an associate at Hage Engineering, located in New York City. His experience spans renovations and new construction projects, including historic renovations, cultural, civil, residential, and commercial projects. He can be reached at 212-358-7778 or ccuono@hageengineering.com. **Sara Grant, AIA, LEED AP,** is an associate at Murphy Burnham and Buttrick Architects in New York City. Her current focus is on incorporating sustainable design into education projects in cost-effective ways. Her experience also includes residential and institutional work. She can be reached at 212-768-7676 or sgrant@mbbarch.com.