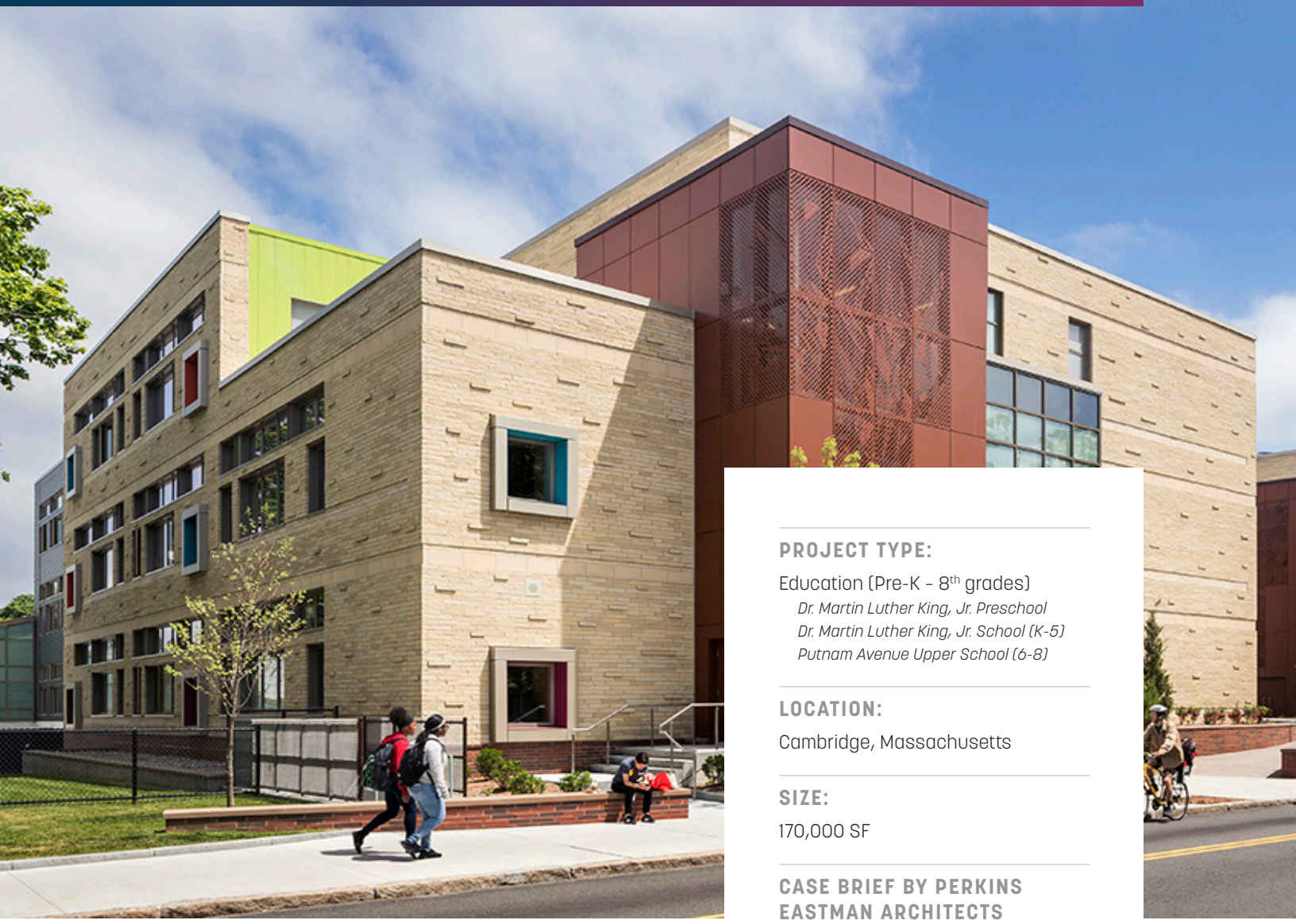
IMPACT OF DESIGN SERIES, VOL. 2

Dr. Martin Luther King, Jr. School

AMERICAN SOCIETY OF INTERIOR DESIGNERS
RESEARCH



PROJECT TYPE:

Education (Pre-K - 8th grades)

Dr. Martin Luther King, Jr. Preschool
Dr. Martin Luther King, Jr. School (K-5)
Putnam Avenue Upper School (6-8)

LOCATION:

Cambridge, Massachusetts

SIZE:

170,000 SF

CASE BRIEF BY PERKINS EASTMAN ARCHITECTS

PERKINS EASTMAN

CLIENT OVERVIEW

Cambridge Green Schools Initiative was looking for a prototype project that could help inform their "Getting to Net Zero Framework" and change how the school district thinks about energy in all of their buildings.

DESIGN CHALLENGE

Dr. Martin Luther King, Jr. School, a Brutalist building fraught with challenges, was selected as the prototype school, and the design team was tasked to create both a high-performing building and a community school that interacted with and responded to its neighbors.

DESIGN SOLUTION

- Optimized building orientation by elongating the classroom bars along the East-West access to maximize daylight and to control heat and glare
- Limited glazing ratio to 31.7 percent and combined interior light shelves with exterior shades to provide well-lit, daylight autonomous classrooms with appropriate glare control
- Careful material selection along with CO_2 meters and operable windows to provide an improved indoor air quality for the sensitive population
- Stacked the program vertically on the tight site to provide both indoor and outdoor educational opportunities for both students and the community.

IMPACT OF DESIGN

- The building's energy use is currently 14 percent lower than modeled, exceeding the project goals significantly, at 27 kBTU/sf/yr, with a net EUI of 15.2 kBTU/sf/yr
- Interior light shelves bounce daylight deep into classrooms, providing a glare-free daylit experience for students and teachers, resulting in 93 percent of people satisfied with the amount of daylight
- A 12-25 percent reduction in CO_2 levels through the use of high-performance systems strongly correlates with a 57 percent increase in occupant satisfaction with air quality
- 100 percent agree the design of the school creates a pleasant place to work and learn, while 79 percent think the school building fosters community between faculty and students

PROCESS

TIMELINE

- Design: 2012-2013
- Construction: 2013-2015
- Post-Occupancy: 2016-Present

PROJECT

PROJECT COSTS

- $368/s.f. (excluding demo/abatement associated with the existing building and photovoltaics)
- Average cost for new public schools in Massachusetts was around $355-$375/s.f. at the time of bidding
- The school chose to buy the solar panels themselves, but could have easily pursued a Power Purchase Agreement (PPA) to cover the entire cost of photovoltaics

PROJECT TEAM

- Architect of Record: Perkins Eastman
- Landscape Architect: Brown Sardina, Inc.
- Project Management Consultant: Michael Black
- Construction Manager: WT Rich
- General Contractor: Rich-Caulfield MLK Venture
- Structural Engineer: Foley Buhl Roberts and Associates
- MEP Engineer: AKF Group
- Civil Engineer: Nitsch Engineering
- Lighting Consultant: LAM Partners, Inc.
- Sustainability Consultant: Soden Sustainability Consulting
- Net Zero: In Posse
- Security and Technology: Garcia, Galuska, DeSousa Inc.
- Furniture Furnishing & Equipment: Point Line Space
- Foodservice: Crabtree McGrath
- Hazardous Materials: Fuss & O'Neill EnviroScience, LLC
- Cost Estimating: VJ Associates
- Code: RW Sullivan
- AV and Acoustics: Acentech
- Specifications: Architx, LLC

OVERVIEW

The Dr. Martin Luther King, Jr. School houses three schools on one campus: the Dr. Martin Luther King, Jr. Preschool, Dr. Martin Luther King, Jr. School, and the Putnam Avenue Upper School (PAUS). The project was complicated by its small and irregular site; the large and complex program accommodating 840 children from preschool to 8th grade; robust after school programs; and an array of engaged stakeholders.

The design goal for the school was to synthesize the Cambridge Public Schools Superintendent's "Innovation Agenda," targeting significantly enhanced educational outcomes within this urban district, with the Mayor's desire to pursue Net Zero Energy (NZE). At first, many stakeholders involved were concerned that the two agendas would result in conflict over financial resources, which could diminish the District's educational and community goals. Instead, the process and design demonstrated a powerful synergy between the Innovation Agenda, sense of community within the school, and the pursuit of NZE. Together, these goals inspired a sustainable, high-performance urban learning environment for its students and the community.

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BACKGROUND

The new Dr. Martin Luther King, Jr. School was erected on the site of a former Brutalist school building campus that was fraught with challenges. To name a few, the former school offered minimal access to daylight and views within core learning spaces, few permeable surfaces and minimal landscaping, and hazardous materials that required abatement.

Neighborhood history, diversity, and income mix were contributing factors in the selection of Dr. Martin Luther King, Jr. School as Cambridge's first in a series of school upgrades. As a community school, care was given to how the school responded to and interacted with its neighbors.

Dr. Martin Luther King, Jr. School became the prototype project for the Cambridge Green Schools Initiative, and the city learned about NZE through the project, which informed the "Getting to Net Zero Framework" adopted in 2015. It changed the way the district thinks about energy in all of their buildings.

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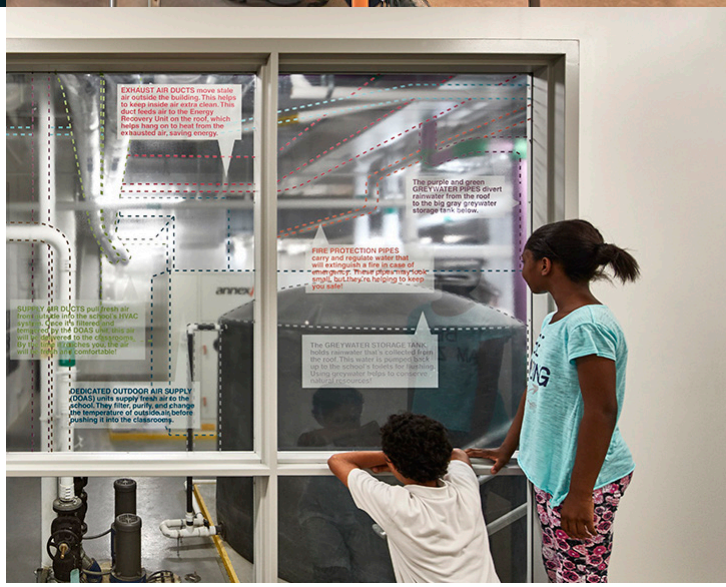
PROCESS



The process started with a Request for Quotation (RFQ) for a Feasibility Study (FS) to explore options to accommodate the program at the site of an existing K-8 school that had been built in 1971 and was in need of extensive repairs and upgrades. This project is the first in a series of school projects to create excellent educational environments that also serve as centers of community for their neighborhoods. Central to the client's goals was to "lead by example in reducing and minimizing greenhouse gas emissions and other environmental impacts..." and study "design options that would create a Net Zero Energy project."

Targeting Net Zero Energy (NZE) early in the process, the project team worked in an integrated fashion to make the smartest decisions upfront. Community members were encouraged to contribute and stay informed through 14 public meetings, parent surveys, email, and the project's website. During design and permitting, 200 meetings were held with project stakeholders including a televised panel aired to help educate the community on NZE.

During this process, the team established an energy budget and reduced demand for energy by working with users to find alternatives to meet their goals. Priority was placed on daylighting to not only help realize targets set for the energy budget, but also to take advantage of the positive impact on educational outcomes. The design team used tools to analyze daylight during the design process. Benefiting from strategies that mitigate glare, many

teachers now opt to leave the electric lighting off, preferring the pleasant "learning ambiance" of classrooms suffused in natural light.

A total of four options were explored including renovation/addition and new. Early energy modeling was used to compare options. A matrix of evaluation criteria was used to objectively select the best option for the project. Although it was evident at this very early stage that the project would not achieve NZE onsite, the city chose to continue the NZE process as a catalyst for change for future projects and to educate the students, faculty, and community about their impact on energy use.

Construction of the new school was completed in December 2015, and students moved in in January 2016, but the project did not stop there. Extensive post-occupancy evaluations have taken place, and the impact of the design decisions continue to be studied over time.

An interdisciplinary team of practice-based researchers, sustainability specialists, leaders in K-12 design, and school administrators collaborated on a comparative pre- and post-occupancy evaluation (Pre-OE & POE) of the project. The process started with design team and client/construction manager post-mortems to document lessons learned. Next, two pre-occupancy sites, the former school locations, and one post-occupancy site, the new school, were evaluated. In both Pre-OE & POE, many sides of student and staff satisfaction, performance, wellness, and other psychological and physiological experiences were explored. Through this process, qualitative and quantitative information was collected to compare actual indoor environmental quality against perceptions and found that even minor improvements in actual building performance resulted in significant improvements in perceived occupant satisfaction. The data can be used to justify high performance strategies to clients by showing the measured value of each strategy and how they can come together to affect building occupants.

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DESIGN SOLUTION AND IMPACT

MASSING

To fit in its residential neighborhood, the building massing steps back, reducing shadows on neighboring buildings. The school's two primary academic wings also provide a welcoming entry with the creation of a public entrance courtyard.

PUBLIC SPACES

King Street, an internal circulation spine, connects the different school communities, from the preschool to the upper school, and helps create different zones and designated areas for schools and publicly shared spaces. King Street enables the joint-use public spaces, such as the lower school gym, upper school gym, cafeteria, and preschool by making them easily accessible and open to the public.

> *90 percent agree the design of the school supports education.*

> *100 percent agree the design of the school creates a pleasant place to work and learn.*

PUBLIC COURTYARD

The upper and lower schools each have a distinct entrance within the main courtyard, promoting their individual identities and creating a welcoming front door to each community.

SECURITY

To reduce bullying and create positive connections, stairs, staff areas, and primary shared spaces selectively have glazing for views to corridors, breakout spaces, and outdoor spaces.

> *97 percent say the new building is a better place to spend their day than the old building.*

LEARNING NEIGHBORHOODS

To reduce the scale of the building and encourage greater interaction between faculty and students, both the lower and upper schools were organized into “neighborhoods” comprised of classrooms, labs, administrative offices, and teacher support spaces. Each school is organized as three “neighborhoods” that were intended to encourage a sense of community among a subset of the school population.

> *79 percent think that the school building fosters community between faculty and students.*

> *76 percent say the large group gathering spaces are successful at supporting a sense of community.*

ACTIVITY

Education flows seamlessly from indoors to outdoors, with terraces and rooftop gardens providing access to the outdoors on every floor. Promoting activity was important in this multi-story school. Stairwells in each quadrant represent a seasonal tree through custom perforated panels that shade the exterior glazing and feature a biophilic pattern. Additional resources include a CitySprouts garden, new food service, fitness room, and playgrounds to encourage a comprehensive understanding of wellness around healthy eating and an active lifestyle.

EXTENDED LEARNING

One aspect of the learning neighborhoods is that circulation space was organized to provide flexible, informal, learning spaces that would allow for small group work to occur outside of classrooms, activating the “corridor” as a space for learning.

> *89 percent of people were satisfied with the noise level in the new school.*

> *82 percent of people were satisfied with the acoustical privacy (noise between adjacent spaces in the new school).*

ACCESS TO NATURE

Both the upper school and lower school gyms have large doors that open up to play space. The garden provides a school-wide learning opportunity.

AIR QUALITY

Improving air quality was especially important due to the sensitive population. Materials selection complies with LEED v2009 materials credits for low VOCs and no added formaldehyde. Measures were taken to provide increased ventilation with CO_2 sensors and to meet pollutant source control requirements. A demand-controlled ventilation system senses classroom occupancy and increases fresh air as needed. All classrooms are equipped with operable windows.

> *A 12-25 percent reduction in CO_2 levels through the use of high-performance systems strongly correlates with a 57 percent increase in occupant satisfaction with air quality (71 percent of staff were satisfied with the air quality in the new school).*

> *The average CO_2 level in the new school is 552 ppm, a 24 percent decrease from the old school.*

DAYLIGHT

Daylight without glare in the learning spaces and corridors contributes to the healthy learning environment. Classroom windows allow appropriate distribution and control through exterior and interior light shelves and sun shades. Care was taken not to over-daylight spaces, limiting the glazing ratio to 31.7 percent overall and reducing the glazing on the west façade of corner classrooms to 9 percent. Interior light shelves bounce daylight deep into classrooms, providing a glare-free daylit experience for students and teachers. Actual measurements of classroom spaces found more area with usable daylighting levels than modeling predicted.

> *93 percent of people were satisfied with the amount of daylight in the new school.*

> *Daylight in the new school building was measured to be 57-65 percent more well-lit than in the previous spaces.*

BUILDING PERFORMANCE

Energy reduction started by optimizing the building orientation (north/south) for primary learning spaces and maximizing daylight through light-shelves and photovoltaic sunshades. Then, a high R-value, air-tight exterior envelope was developed with thermal bridging minimized. To mitigate the extended hours of operation (6 a.m. – 11 p.m., year-round), mechanical zones can turn on and off as needed. Efficient systems include a geothermal well system that supports individualized heat-pumps for heating/cooling and demand controlled ventilation to provide fresh air supported by energy recovery units. This both optimizes energy use by reducing HVAC demands and increases occupant comfort.

To further reduce loads, occupants were actively engaged in the task of reducing plug loads. 41 percent of the expected energy use was attributed to plug loads and 20 percent was attributed to lighting, so occupant behavior significantly impacts energy use. Every plug load and each room schedule was analyzed to correctly model loads and identify areas of savings. To ensure maximum daylight, clerestory window shades automatically reset to "open" so teachers don't leave them closed when unnecessary.

With the project opening in January 2016, a little more than a year's worth of measured data has been collected on the building. The success of the Dr. Martin Luther King, Jr. School has led to new district-wide policies in Cambridge around plug loads, food service, maintenance, and waste. Succinctly summarizing the results, one teacher remarked, "My life is better because I teach in this building."

The total energy use intensity (EUI) after the first full school year of occupancy came in under predictions, exceeding the project goals significantly, at 27 kBTU/sf/yr, with a net EUI of 15.2 kBTU/sf/yr.

Through good design and an informed process, the building's energy use is currently 14 percent lower than modeled.

100 percent are proud to work in this building.

ABOUT PERKINS EASTMAN

Perkins Eastman is a global architecture and design firm guided by the belief that design can have a positive and lasting impact on people's lives. With more than 1,000 employees in 15 locations around the world, we collaborate seamlessly across borders, barriers, and disciplines to connect people and ideas. Whether conceiving of new healthcare models, reviving a local landmark as a boutique hotel, or helping communities become more resilient, we are united in a dedication to progressive and inventive design that enhances the human experience. If everything is design, everything we do is HUMAN BY DESIGN.