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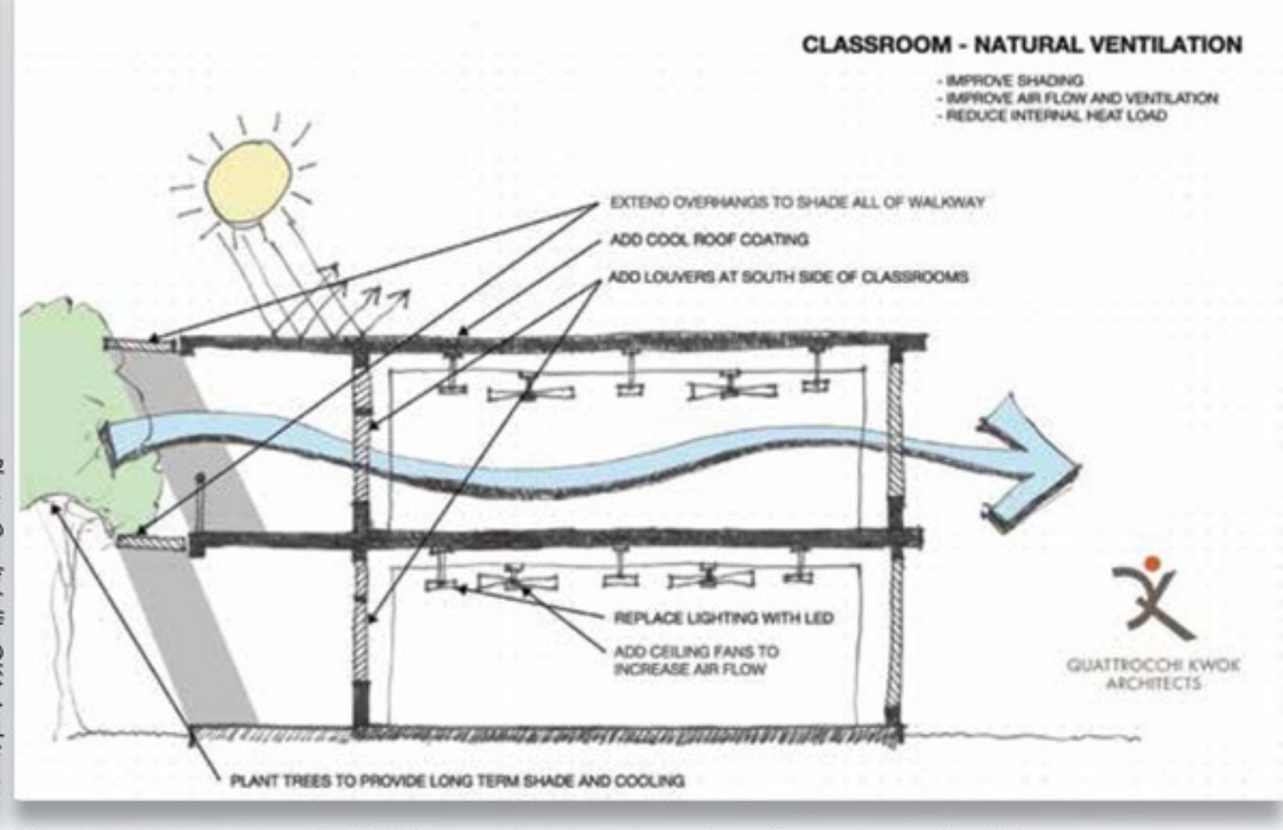
For The Cove Elementary School in Larkspur, Calif., QKA worked with staff on classrooms that allowed daytime use without reliance on artificial lighting.



The state of Hawaii asked QKA to evaluate and analyze elementary schools in Honolulu to identify and recommend strategies for reducing overheating and increasing student comfort.

Approach Efficiency with Old-School Intuition & New-Age Measures

By Mark Quattrocchi

Like most architecture students in the late 1970s, I have humble beginnings with infusing energy-efficiency considerations in design. As a University of California, Berkeley architecture student, energy-efficient design was more intuitive than calculated, with design tools limited to daylight study models or paper sun-angle calculators. After graduate school, I briefly worked for the Passive Solar Group at the Lawrence Berkeley National Laboratory doing glazing and sunshade studies using a room-sized computer — calculations that can now be done by the mobile phone in my pocket. But for the practicing architect, techniques used since ancient times that consider building orientation, ventilation, materials and daylight were what we used to create energy-efficient design.

Today, as I work with numerous school districts now armed with a dazzling array of design technologies and specialized energy consultants, I am reminded how important some of those simple design techniques remain. It is not uncommon for a district to ask about installing photovoltaic solar panels while still operating schools that consume huge amounts of energy from buildings that leak air and run inefficient mechanical and lighting systems. Certainly, investing in on-site energy generation and energy storage systems are vital to high-performance schools, but we must also implement readily available energy-saving measures.

I always work to help clients determine the best approach to their energy reduction strategies that considers short- and long-term cost savings, resources, environmental stewardship and student/educator health and academic success.

Energy Savings

Energy-efficient facilities, from both an environmental stewardship and cost-saving standpoint, have made their way into the ethos of architects and school-facility staff. My firm, Quattrocchi Kwok Architects (QKA), based in Santa Rosa, Calif., is located in a state that has been at the forefront of energy-efficiency progression, regulatory measures and rebate programs. Recently adopted California energy codes and funding opportunities reflect the school construction industry's commitment, with tangible energy savings for school districts. Examples include the adoption of CALGreen energy standards and legislation such as the California Clean Energy Jobs Act (Prop 39) to provide funding for energy efficiency and clean-energy generation in schools. With its more than 40-year commitment to energy efficiency, California's energy use per capita is now the fourth lowest of all the states, according to the U.S. Energy Information Administration.

The energy savings provided by facility improvements have a tangible measurable benefit to a school district's General Fund. In some states, such as California, funding for facility capital improvements are separate from operational or General Fund expenditures. Historically, this separation has disincentivized school districts from spending their limited facility funds on improvements with higher initial costs, even when they produce long-term savings. However, as energy costs have soared and with better access to funding programs such as Prop 39, school districts are implementing energy-savings measures on new and renovated school projects that have a lasting benefit to the General Fund.

General Fund savings from Prop 39 is abundantly clear, according to the California Energy Commission. Since 2013, more than 2,176 Local Educational Agencies have received $1.4 billion in Prop 39 funding, resulting in annual energy cost savings of more than $74.8 million. Additionally, these school facility improvements have reduced greenhouse gas emissions by nearly 280 million pounds of carbon dioxide. Most of these improvements are lighting and lighting controls, mechanical systems and solar photovoltaic generation.

Strategies to Increase Efficiency

There are numerous studies on the positive impacts to learning environments, for students and teachers, provided by energy-efficient schools. As such, more and more schools are coming up with practical strategies to increase efficiency.

- **Building Solar Orientation:** Generally, buildings in the northern hemisphere that run east-west provide several energy-savings opportunities. With the sun traveling in the southern portion of the sky, an east-west building orientation with prominent glazing on the north and south facades can improve classroom daylighting with north-facing windows. These provide diffused daylight with minimal direct sun. Southern glazing is easily controlled with well-placed horizontal exterior sun-shade overhangs. Similarly, this orientation can allow rooftop solar panels a southern orientation to maximize photons reaching solar cells. While east- and west-facing solar panels also work, the southern orientation provides the greatest sun exposure for the panels.
- **Daylight & Artificial Lighting:** Much is known about the quality of learning environments and improved test scores of well daylit classrooms, including evidence-based studies provided by Pacific Gas & Electric and the California Energy Commission. With artificial lighting being one of the highest uses of energy in schools, strategies that reduce their dependence will translate into reduced costs and improved learning outcomes. Classroom daylighting requires careful consideration to ensure balance. As a general rule, seek classroom design strategies that provide daylight from at least two sources to avoid harsh contrast glare. Careful considerations for exterior sun shading is also important to avoid unwanted direct sunlight. Roof monitors, dispersed skylights or solar tubes can also be useful options.
- **Exterior Sun Shading:** Far too many schools rely on air-conditioning that is expensive to operate or window blinds that stop the sun on the wrong side of the glass. Oftentimes, simple exterior sun-shade devices or careful placement of tress can stop the sun's rays before they enter a classroom. This simple strategy, combined with natural ventilation can greatly reduce cost of energy and teacher consternation in overheated classrooms.
- **Natural Ventilation/Cooling:** Reduced energy costs, increased thermal comfort and improved indoor air quality are attained with thoughtful natural ventilation strategies. In many climates, the use of moving air through nighttime flushing, wind drive ventilation or stack effect (air movement by the buoyancy of warmer air) can increase days of thermal comfort, without relying on air condition. The simple act of adding operable windows and low-energy ceiling fans can transform the comfort level of an overheating classroom.
- **Commissioning:** Commissioning is an excellent method to ensure the success and viability of complex systems, including energy, mechanical and electrical. Required for larger California school projects, building commissioning is a quality-focused process from initial design through post-occupancy, ensuring the success of building systems that include establishing project requirements, benchmarks for success, reviews, training and performance testing.
- **Solar Ready:** Even if there is no budget for solar photovoltaic panels, preparing the roof structure for future panels including electrical pathways is an inexpensive way to allow this to occur in the future.

Mark Quattrocchi, AIA, is a principal at Quattrocchi Kwok Architects. He can be reached at markq@qka.com.