Lessons Learned: A Symposium on School Design
LAUSD / USC School of Architecture / J . PAUL GETTY Trust

Session: 4C - Lighting

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Key Issues:
How to utilize natural light more effectively in order to maximize the benefits of daylighting but minimize direct beam penetration and solar heat gain.
How to design daylighting to incorporate lighting controls that save lighting energy.
How to consider the orientation of the classrooms with respect to the sun in order to achieve and enhanced usage of natural daylighting effects.
How to consider other ways to maximize the lighting of classrooms with natural light.
How to consider means to get natural lighting system into all parts of the building including corridors and ensure that energy savings gains exceed energy losses from increased solar load when implementing these systems and how to integrate the use of solar power.
How to utilize more energy efficient lighting systems and take full advantage of technological advancements in this area.
How to balance the light in the parking garages so that security cameras can work, with out requiring an excess of energy to be spent.
How to provide for better exterior lighting to enhance safety and nighttime use.

Constraints, Problems, and Design Opportunities:
Although natural lighting is extremely desirable, glazing systems can be expensive and depending on the orientation, sun shading devices may also be required to help achieve natural lighting goals and not create excessive heat gain. Examining the site design with an eye towards optimizing the classroom orientation with respect to lighting conditions can be a useful way to enhance natural lighting conditions with in the classrooms. This is especially critical on some of the tighter sites. More natural light in the classroom could not only reduce the energy needs, but it can enhance the educational process.

Examining the relationship to the sun, the height of the ceiling and the shape of the classroom can also enhance how natural light effects the classroom. If the allowable windows in a classroom are limited, then considering the specific relationships of light with in the classroom can help to optimize it. Also, while considering the interrelationship of light and spatial arrangement, it is also important to remember that flexibility in lighting conditions is important too.

Indirect natural lighting systems in general can be costly, although utilizing them in other areas of the school such as corridors could lessen operational costs, as could integrating solar panel designs. There is not currently an ability to measure these future operational savings against the increased construction budget necessary to realistically accomplish these goals.

Although the district guidelines call for the use of T.8 lamps, there is often disapproval from maintenance crews when actually trying to implement the usage of T.8 lamps. Also there can be problems with the unions when trying to invoke other technological upgrades. There is a tendency due to these difficulties to revert to the current classroom lighting standards, which are far from ideal in terms of lighting quality.

In schools on limited sites where parking garages are required, the lighting requirements for the garage are often very big to accommodate security cameras. This increase in the lighting budget in this area takes away from the lighting budget in other areas.

Developing a more sophisticated understanding of the nighttime lighting of the schools can help provide better planning in this area. Better lighting can enhance the community usage of the school, the perception of the landscaping at night and nighttime security. However, nighttime lighting must be balanced between accomplishing these goals and not being so bright that it is an intrusion on the neighborhood.

Solution Types:
One solution strategy to optimizing natural light in the classroom is to orient the classroom wing on the North South axis, this can save as much as 6% on energy usage. There are obvious advantages to northern light for energy calculations and southern light can be very effective when it is shaded properly.

When there are site constraints or tight sites an East West orientation has been used for the classrooms. In these types various sun shading devices such as horizontal louvers or vertical fins can help to mitigate the direct light.

Another device to maximize the potential of natural light is the use of light shelves which can simultaneously shield the light and bounce light further into the depth of the classroom. If the tops of the light shelves are mirrored the throw of light can be increased from 18 feet to as much as 36 feet. These means can reduce energy consumption.

Clear story lighting is another type of light that can help with indirect natural lighting methods. Again depending on the orientation sensitivity to shading may be important.

Some projects look at ways to bring natural light into the corridors and then borrow that light from the corridor into the classroom to supplement the light from exterior edges. One of these examples makes these corridors exterior covered spaces to help offset the cost of this added feature. Other projects looked at more typical skylights or light scoops to accomplish these goals, but found it difficult to manage the costs of these in the overall budget when the hallways were enclosed.

Some projects are starting to look at the lighting in the classroom and they are trying to create flexibility into the lighting system. One example is offset switching so that different levels of light can be achieved in the classroom depending on the particular activity, the individual desires of the teacher or the weather on that particular day. This flexibility not only allows customization, but it can also mean saving energy.

For lighting in the classroom there are many examples of how new technology in lighting can have a positive effect. Microprocessors can be used to turn shading devices up and down. Also the technology to allow harvesting electricity is very low -tech, but is difficult to implement because existing standards within the schools. The computerization of shutting on and shutting off of lights is also simple and could facilitate energy efficiency.

Examples:
Central LA Area New High School #10, Johnson / Fain
Central LA Area New Middle School #1, TDM
Otis New Elementary School, Kazumi Adachi
Marshall New Primary Care #1, Studio Works / Jerde
Ramona New Elementary School, Tetra Design
Hollywood New Cont High School #1, Perkins & Will
Barton Hill Elementary School - Addition, Sorcinelli Architects
Nevin Avenue Elementary School - Addition, Kanner Architects
Central LA New High School, Studio Works / Jerde
Belmont Primary Center #11, Gonzalez / Goodale
Central LA Area New High School #9, A.C. Martin
Jefferson New Elementary School, Hak Sik Son Arhcitects
Central LA Area New Middle School #3A, Gonzalez / Goodale

Recommendations:
If architects are given more time during the schematic design phase, then they would be able to spend more time analyzing the site and the sun's orientation in order to create better site solutions. Such solutions could not only address other complex issues of the site, but also allow a development of the site with respect to classroom orientation. With a longer schematic design period there would be more time to

properly synthesize all of issues involved in the complex planning of the sites.

The district could also help facilitate the integration of natural lighting features by capitalizing on the large number of schools being designed and creating a light lab where architects can test classroom prototypes.

Also if the budgets for the schools could include enough to hire lighting and or energy consultants, there would be expertise to analyze how lighting strategies can effect actual light gain in the room and aid in the development of methods to enhance energy usage.

Related to this would be for the district to find a way to make credits for features of the design such as solar energy devices or light shading devices where future energy savings is created but the construction cost is elevated. Since the district is such a large entity, is there a way to create energy efficient solutions with front-end costs that would be understood in terms of their future value, to the district? Could the district also take advantage of free analysis from Edison to analyze the feasibility of this type of energy savings, which could effect future operational costs?

Could the district take advantage of their buying power to upgrade the typical lighting systems so that they both include more energy efficient lighting and a better quality of lighting? For instance could they get a manufacturer to create an affordable T.8 or T.5 light fixture that would be a 70/30 up/down light or a 30/70 up/down light both with reflectors and diffusers in order to create a better quality of light?