Volume : 1 | Issue : 5 | Oct 2012 • ISSN No 2277 - 8160

Research Paper | Architecture

An Overview of Energy use and Energy Efficiency Opportunities in Schools Buildings

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ABSTRACT

Today Indian government is in great search to provide primary education to each and every children of India. the proposal of RTE (right to education) and allocating lot of funds for promoting primary education and mid day meal system are some bold examples of government vision towards primary and secondary education in India in feature. That primary requirement obviously generates a huge need of constructing new buildings for schools at urban and rural level in all over India. That's why there is great need to study and develop a system of constructing energy efficient school buildings that provides batter environment for primary and secondary Education without harming the environment and reducing the running cost of the buildings.

The study aims to analyse the following:

- *Study the concepts and ways to develop Energy Smart Schools building.*
- *Design approach and strategies to develop system of constructing Energy Smart Schools building.*
- *Analyse Cost Constraints in developing Energy Smart Schools building.*

KEYWORDS: Energy Smart Schools, running cost of the buildings, right to education and environment.

1.0 Introduction:

Schools are central to the communities they serve and should reflect community values – like energy and resource conservation and great place to teach the nation's children about energy and resource conservation.

As we know Indian government is in great search to provide primary education to each and every children of India creates huge need of constructing new buildings for schools at urban and rural level in all over India that Promotes better environment for primary and secondary Education in the country demands great need to develop a system of constructing Energy Smart school building.

Energy Smart school building can impact the comfort and health of students and staff, which, in turn, can affect concentration, attendance, and student performance.

2.0 Energy Smart Schools:

Energy Smart Schools mean healthier children and teacher and a healthy planet, Energy-efficient, high-performance schools having healthy learning environments that combine good lighting, comfort, acoustics, and air quality. These schools can save thousands of rupees in operating costs annually – that can be re-directed to education resources.

The selection of constructing material is on the energy saving bases. And their life time running cost pre evaluated. That promotes eco friendly sustainable built environment in schools for better primary and secondary Education.

As result it incorporate the very best of today's design knowledge and technology to provide better learning environment for children in a facility that costs less to operate and is less damaging to the environment.

2.1 Why Energy Smart Schools:

Every school faces different environmental challenges but many of the same constraints

- Limited funding.
- Rising energy and maintenance costs.
- Lack of resources and technical assistance.
- Lack of time to research resources.

According to personal survey in most air conditioned and conventional schools, energy is the biggest operating expense. Schools spend more on energy than any other expense except personnel.

A high-performance school doesn't have to cost more to construct than a conventionally built school as we will analyse in case study and can lower a school operating costs by up to 30%. Energy is one of the few expenses a school can reduce without sacrificing educational quality.

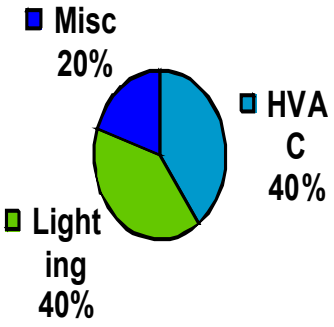


Fig 2.1.1 Typical school Building Electrical Costs

Schools are central to the communities they serve and should reflect community values – like energy and resource conservation and great place to teach the nation's children about energy and resource conservation.

High-performance schools can impact the comfort and health of students and staff, which, in turn, can affect concentration, attendance, and student performance.

3.0 Making schools energy efficient:

Building an energy-efficient school depends on "whole building" systems design, which requires more planning than for most conventional schools. Whole building design weighs a wide range of options to find optimal design solutions that meet the defined project goals and fit the school's size, functions, and climate zone.

3.1 Energy Efficiency Opportunities in schools:

Schools can save energy in a variety of ways.

Low-Cost Measures:

- Measure and track energy performance.
- Turn off lights when not in use or when natural daylight can be used.
- Set back the thermostat in the evening and other times when a

building is unoccupied.
- Perform monthly maintenance of heating and cooling equipment to guarantee efficient operation throughout the year.
- Reusing paper and recycling paper saves money and energy. Recycle aluminium cans and plastic bottles.
- Educate students and staff about how their behaviours affect energy use. Some schools have created student energy patrols to monitor and inform others when energy is wasted.
- Use ENERGY STAR Target Finder to integrate efficiency goals into the design of new properties.

Cost-Effective Investments:
- Install energy-efficient lighting systems and controls that improve light quality and reduce heat gain.
- Use a performance contract to guarantee energy savings from upgrades.
- Work with an energy services provider to help manage and improve energy performance.
- Upgrade and maintain heating and cooling equipment. Replace chlorofluorocarbon chillers, retrofit or install energy-efficient models to meet a building's reduced cooling loads, and upgrade boilers and other central plant systems to energy-efficient standards.
- Purchase energy-efficient products like ENERGY STAR qualified equipment.
- Install window films and add insulation or reflective roof coating to reduce energy consumption.

4.0 Cost Constraints in new energy smart school Buildings:
- Efficient Buildings Are Not Necessarily More Expensive:
- Based On Research, And Local Experience, Integrated Designs Improve Quality And Efficiency, Without Increasing Total Cost Of Project.
- Efficiency Requires More Thinking, Not More Money.

4.1 Cost-Effective systems:
School typically separate their capital and operating budgets and therefore have little incentive to factor in the long-term cost of a building when making decisions about its design and construction. However, to reduce the total cost of owning a building while ensuring its quality,
- It is necessary to balance the initial design and construction costs with the cost of lighting, heating, cooling, repairing, and otherwise operating and maintaining the facility.
- Select building elements on the basis of life-cycle cost analysis Mirror the lifespan of projects and systems with the expected lifespan of the facility.
- Consider the recyclability of materials.
- Specify materials and products that are easy to maintain (balance this with their impact on children's health and the environment).
- Utilize life-cycle cost analysis tools.
- Commission the facility to ensure that it operates in a manner consistent with design intent.
- Use energy simulation and analysis tools to optimize energy performance (integrate day lighting systems, high-performance HVAC, energy-efficient building shell, and high-performance electric lighting).

5.0 Ways of energy efficiency uses in schools:
n Dena Boer Elementary School—Salida, California
- Skylights are used to distribute natural daylight to the classrooms, library, multipurpose room, and offices of this 800-student, K-5 school. Fig 5.1.1



Fig 5.1.1: Interior lighting of a classroom

- Louvers installed in the skylight wells help control daylight levels and can be used to darken rooms when necessary.

n Glebe Elementary School: Arlington, Virginia, (by Barrio Architecture + Interiors)
- Passive solar design strategy incorporated into the exterior of the building. (Fig 5.1.2)



Fig. 5.1.2: Exterior Spaces

n Boscawen Elementary School—Boscawen, New Hampshire



Fig 5.1.3: Corridor lighting
- 'Room like,' non-institutional corridors, plenty of views out and in, and windows between the classrooms and the hallway all combine to improve the safety and sense of security in this New Hampshire school. (Fig 5.1.3)

5.1 Case study: Northern Guilford Middle School Greensboro, North Carolina: by Joe Hill Facilities Consultant, Guilford County Schools

Project Details:
Building: Single story, 140,000 square feet
Completed: January 2007
Financing: General Obligation Bonds
Cost: $20.7 million; $148 per square foot; $21,789 per student
Capacity: 950 students
Energy performance and savings: 43% below a comparably sized school based on ENERGY STAR® data; $77,097 annual reduction in energy cost.

Energy costs: $0.65 per square foot per year and approximately 45,000 Btu per square foot annually.

5.1.1 Goals:
- Reduce operating costs.
- Protect the environment.
- Design buildings three-dimensional.
- Improve academic performance
- Optimize health, safety, and comfort.

One of the key goals for the team was to design Northern Guilford Middle School to be a three-dimensional educational experience. Students get a hands-on look at conservation and renewable energy through all the features at the school, including a wetland ecosystem. The learning opportunities at Northern Guilford will increase awareness of energy use and environmental issues for future generations.

5.1.2 Energy Modelling and Trade-Offs:
- The design team used the eQUEST (Quick Energy Simulation Tool) interface to the DOE-2 simulation program to perform extensive energy modeling.

- The modeling, conducted throughout the design and construction phases, helped balance the heating and cooling needs based on all the systems, including lighting, the under-floor air distribution system, and the variable air volume system.

5.1.3 The unique systems in Northern Guilford Middle School:

- First, the lead architect on the project, Innovative Design, developed a new day lighting design. uses south-facing clerestories with curved, interior, translucent light shelves that produce more diffused light throughout the classroom. fig5.1.1
- also incorporates an under-floor air distribution system in the classrooms, media center, and administrative offices, which eliminates ductwork in the ceiling that can interfere with day lighting.

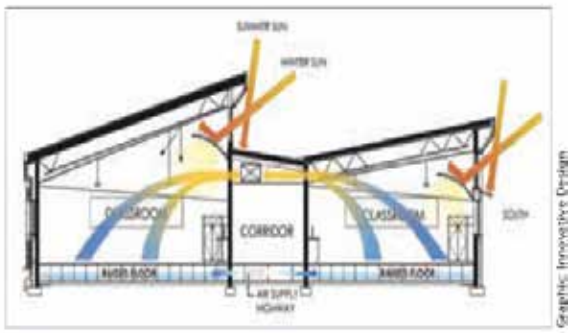
The new light shelf design and the unobstructed Ceiling mean less glazing is needed to reach the desired day lighting level, which translates into lower cooling loads. Clearly, every design decision influences other decisions, so optimizing all the systems concurrently helps develop the most efficient school at the least cost.

5.1.4 Northern Guilford Middle School Energy-Related Goals:

1. Decrease energy use to about half that of a typical school. Based on ENERGY STAR® data, a typical school uses about 79,500 Btu per square foot annually.
2. Reach an optimal level of day lighting to improve student and faculty performance and maximize energy savings.
3. Reduce the size of the school's heating and air-conditioning system.
4. Lessen water consumption significantly.

5.1.5 Project Outcome:

1. Northern Guilford Middle School currently uses about 45,000 Btu per square foot annually, which is 50% to 60% of the energy used by a similar school in this climate.
2. Natural light is the primary source of lighting for all educational and administrative spaces during two-thirds of the daylight hours. This level of day lighting minimizes the fenestration-to-wall area ratio and eliminates heat gain from extra glazing.
3. The central boiler/chiller is 20% smaller than a typical system for a school this size.



Schematic section of classrooms showing daylight strategies

Fig. 5.1.4: Natural lighting

4. By collecting rainwater for use in toilets and implementing a plant-based treatment strategy, called a Living Machine, to purify wastewater for irrigation, the school saves roughly 9 million gallons of water per year.

5.1.6 Results:

Northern Guilford Middle School requires about half the energy of typical schools. The integration of day lighting, a highly insulated building envelope, and an under-floor air distribution system enabled the size of the air-conditioning system to be reduced by 75 tons.

DOE-2 energy simulations indicate the day lighting strategy reduces lighting energy use by 50 percent, peak load by 11 percent, and overall energy use by 19 percent compared to the ASHRAE 90.1-2001 base model.

- All this was accomplished at the same cost of a similar, conventional school. And the school is expected to save more than $70,000 annually in energy costs, or about $0.50 per square foot, bringing the lifetime cost of the building below that of a standard school. Planning and a whole-building



Fig 5.1.5: Comparative energy costapproach make these energy-saving features possible at no additional cost.

6.0 Conclusion:

A huge need of constructing new buildings for schools at urban and rural level in all over India. as Indian government is in great search to provide primary education to each and every children of India. the proposal of RTE (right to education) and allocating lot of funds for promoting primary education and mid day meal system are some bold examples of government vision towards primary and secondary education in India in feature. That's demand great need to develop a system of constructing energy smart school building that provides batter environment for primary and secondary Education without harming the environment and reducing the running cost of the buildings.

For developing energy smart school buildings the following stepwise should be follow

- Plan carefully at the beginning of the design process and sustainable, energy-efficient schools do not cost more.
- Do the right analysis to understand the trade-offs with various technologies.
- Follow a commissioning process to achieve peak performance and efficiency.
- Concentrate on the controls, as these pose the biggest problem in achieving high levels of energy efficiency if not set properly and monitored.
- Design the day lighting so that teachers and students do not need to be actively involved in managing it.
- Supplement day lighting with indirect lighting because it has a similar look.
- More work is needed in humid climates where moisture must be removed from the air but the air does not necessarily need to be cooled.
- Provide good training and orientation for the building staff.

That is a step towards sustainability. And attracts children towards school education.

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