Chapter Three
Design Criteria of Sustainable School
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3.1 Definition of Sustainable School

“Whether it is termed "Sustainable", "High Performance", "Green", or "Environmentally-friendly", is the design will be sustainable in the future, people have varied notions about what sustainable building and schools means. Some think the sustainable schools means saving energy. Others think it means protecting the environment. While these are important aspects of sustainability at school buildings, but they are not sufficient to describe it, because sustainability has a human dimension as well, for the students and teachers at the school buildings.

Sustainable school building can provide improvements in lifestyle, comfort, satisfaction, and health along with protecting ecosystems and saving energy and resources. It integrates the project designing, planning, and engineering, in order to work with, not against nature. Sustainable school building practices incorporate nature's "free" services (wind, sun, thermal properties, greenhouse principles, light, etc.) to create a high quality indoor environment while circumventing as much damage to the ambient environment as possible".  

3.1.1 High Performance School

"High Performance School" refers to the physical facility. Good teachers and motivated students can overcome inadequate facilities and perform at a high level almost anywhere, but a well-designed facility can truly enhance performance and make education a more enjoyable and rewarding experience. A high performance school is healthy; thermally, visually, and acoustically comfortable; energy, material, and water efficient; safe and secure; easy to maintain and operate; commissioned; has an environmentally responsive site; is a building that teaches; a community resource; is stimulating architecture; and is adaptable to changing needs”.

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2 John Sorrell CBE Chair, (2007), cabe, Creating excellent secondary schools, a guide for clients.
High performance school is the sustainable school; the research will use CABE guidelines for the study of sustainable schools.

3.2 **CABE “Commission for Architecture and the Built Environment”**

"CABE is a national body in UK, almost everything they do is local. They work on behalf of the public and they want to inspire public demand for good design, helping people (student & Teachers) to shape the look and feel of places where they live and learn. They have built a large, strong network of local design advisers, all leaders in their professions – architects, planners, engineers, landscape architects, urban designers and surveyors. They give advice that is specific to each place."

“At UK, there is project BSF “Building Schools for the Future”” CABE is supporting those involved in the BSF program by:

- Advising local authorities on the procurement process.
- Assessing school designs.
- Training school leaders and client design advisors.
- Offering guidance and research.
- Reviewing designs put forward by bidders during the Competitive stage of BSF.

Through all of this work, they have acquired a wealth of knowledge about the processes involved in school building projects. To bolster their schools design advice, they have recently established a schools design assessment panel – a group of specialist experts offering detailed advice on school building designed through BSF. The research is trying to understand the criteria of design from CABE”

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1 John Sorrell CBE Chair, (2007), cabe, Creating excellent secondary schools, A guide for clients.
Egypt needs national bodies to develop the Egyptian Schools. The research will discuss the Criteria of CABE and the possibility to apply these criteria in Egyptian schools to become High performance schools and sustainable Educational Building.

3.2.1 The Importance of Good Design

Good design is about providing schools and spaces that are fit for purpose and built to last, but also lift the spirits of everyone who uses them. The design of schools can promote the performance of pupils and a more creative approach to teaching and learning.  

A UK study of pupil performance found that capital investment in school buildings had a strong influence on staff morale, pupil motivation and effective learning time.  

Studies on the relationship between pupil performance, achievement and behavior and the built environment have found that test scores in well-designed buildings were up to 11% higher than in poorly designed buildings.  

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Good design can help recruit and retain staff, cutting the costs of staff turnover. And, in another education sector, around 60% of students and staff have indicated that the quality of building design affected their choice of university. Good design makes public services easier to deliver and so improves productivity. At one school, the redesign of the playgrounds and school hall allowed supervisors to see the students easily in communal areas.

Although well-designed environments can undoubtedly support successful teaching and learning, no one would suggest that design alone can raise educational achievement. However, poor design can be an obstacle to raising educational standards above a certain level.

3.2.2 Main Goals of Sustainability in School Design:

- “Result from a well understood, and organization-wide, proactive commitment to engage in sustainable development as a positive social and economic driver.

- Meets the functional needs of the school and integrates with the wider community through consideration of shared and communal facilities and mixed-use development.

- Recognizes people as the most important assets of a school

- Enhances the teaching and learning environments through healthy and vibrant internal environments including excellent levels of natural light and ventilation and quality external environments that facilitate outdoor activities

- Does not endanger the health of the occupants, or any other parties, through exposure to pollutants, the use of toxic materials or providing host environments to harmful organisms

- Is responsive to local community needs, requirements and aspirations,

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1The value of good design, CABE, London, 2002
2John Sorrell CBE Chair, (2005), cabe, Design with distinction: the value of good design in higher education, CABE, London.
• Enhances biodiversity locally by landscaping based on best practice guidance and globally by not using materials from threatened species or environments.
• Does not cause unnecessary waste of energy, water or materials due to short life, poor design, inefficiency or poor construction and manufacturing procedures
• Uses materials that are environmentally benign in manufacture, use and disposal
• Is affordable to run and simple to manage and maintain in a benign manner.
• Does not consume a disproportionate amount of resources, including land during construction, use or disposal
• Uses renewable and recycled and recyclable resources wherever possible
• Has a green travel plan at inception to create minimum dependence on polluting forms of transport and encourage access to, and the development of, safe, non-polluting and sustainable forms of transport.
• Is flexible to facilitate changes in demographics and technology and allows expansion or contraction in the future, where appropriate”.

3.2.3 The Design Quality Indicators

Design quality should be discussed, specified, evaluated and checked at various stages throughout the design and procurement process.

This will relate to things that can be scientifically measured, such as the level of daylight in a classroom, or to more subjective aspects such as the attractiveness of the building or how it makes you feel.

At the outset of the project, there are many factors to be considered and many individual views to be taken into account – not least the views and aspirations of the school community.

The design quality indicators are the things we look for in a well-designed building.

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They come under three main headings:

![Venn diagram]

**Diagram 3.2 Venn diagram**

The best designs will be right at the centre, strong in all three areas, although not all for each of the main design qualities (functionality, built quality and impact) there are several things that are indicators of good design.  

The research will take the following criteria as framework points to make a new sustainable school and develop the current school buildings to be sustainable schools.

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1 Venn diagrams or set diagrams are diagrams that show all hypothetically possible logical relations between a finite collection of sets (aggregation of things). Venn diagrams were conceived around 1880 by John Venn.

2 Ben Spencer, Head of Education, (February 2006), buildings and spaces: learning from every angle, issue 9, page 7, 8
3.2.4 Criteria for Successful Sustainable School Design

The following CABE 10 points are the criteria against which each design is assessed in the research. The sub points are indicators of the success of a design and are the primary issues considered when scoring a scheme in relation to each of the criteria. Because design issues vary widely between sites and projects, this is not a conclusive list. ¹

The following criteria provide a framework for reviewing design proposals for school renewal projects.

1. Identity and Context:

Making a school the students and community can be proud of:

The design of a place can create a sense of belonging, and reinforce local culture and identity so that people feel a sense of ownership and pride. Buildings and public spaces help to make places distinctive and inspiring.

Site Investigation

This sequence of drawings shows the factors affecting the site (relationship with the neighborhood). ²

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² http://www.cabe.org.uk/design-review/schools/identity-and-context-b
Figure 3. 3 Environment and access and views. “www.cabe.org.uk/design-review”.

Figure 3. 4 Access-separate entrances.
“www.cabe.org.uk/design-review”.

Figure 3. 5 Site as mediator-two polarized communities. Landscape spaces-different activities in the landscape. “www.cabe.org.uk/design-review”.

Figure 3. 6 Density, Shadows and Green spaces. “www.cabe.org.uk/design-review”.

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## (Table 3.1) Identity and Context

<table>
<thead>
<tr>
<th>School ethos and identity</th>
<th>Relationship with neighborhoods</th>
<th>Civic character</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Is the educational vision successfully manifested in the design?</td>
<td>• Does the design respond and contribute positively to its locality?</td>
<td>• Does the scheme establish an appropriate civic presence for the school in the neighborhood?</td>
</tr>
<tr>
<td>• Is the school design inviting to the local community?</td>
<td>• Does the design enhance the character of the neighborhood?</td>
<td>• Will the design strengthen the image of education locally?</td>
</tr>
<tr>
<td>• Does the design respond and contribute positively to its locality?</td>
<td>• How does the massing of the design contribute to the adjacent streetscape or landscape?</td>
<td>• How does the design communicate that this is a public building?</td>
</tr>
<tr>
<td>• If the school has a specialism, how has this influenced the design priorities?</td>
<td>• How does the design improve local movement routes?</td>
<td>• What will the first impressions of the building be?</td>
</tr>
<tr>
<td>• Does the design help foster pride and ownership in the school?</td>
<td>• How does the design address planning issues?</td>
<td>• How does the school relate to the street?</td>
</tr>
<tr>
<td>• Has the school ethos been defined? If so, how has this been expressed in the design?</td>
<td>• How does the school relate to local buildings and landmarks?</td>
<td>• How does the school improve social cohesion in the community?</td>
</tr>
<tr>
<td>• How does the scheme promote inclusion?</td>
<td>• How does the design impact on local views?</td>
<td></td>
</tr>
<tr>
<td>• How does the design of entrance express regard for the school community?</td>
<td>• How does the proposal respond to the grain of the context?</td>
<td></td>
</tr>
<tr>
<td>• Is there a welcoming view of the school from the street?</td>
<td>• How does the design relate to a holistic vision for the area?</td>
<td></td>
</tr>
<tr>
<td>• Is there an element from an existing building that provides continuity of identity?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If the school is co-located do the individual schools require their own identity?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• How do the school’s community facilities respond to different patterns of access?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Is learning visible on arrival to give a good first impression?</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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2. Site Plan

Site plan is making best use of the site-Criteria for good school design-

Enhancing the character of the site.

![Figure 3. 7 School Existing Building.](http://www.cabe.org.uk/design-review/schools/identity-and-context (Accessed 2009)).

![Figure 3. 8 The Existing Building and the new school.](http://www.cabe.org.uk/design-review/schools/identity-and-context (Accessed 2009)).

![Figure 3. 9 Phasing diagrams – New school building is replacing the old building.](http://www.cabe.org.uk/design-review/schools/identity-and-context (Accessed 2009)).

Working with existing site constraints and opportunities. This sequence of drawings shows how the project will be phased to retain the existing buildings during construction of the new school. In schemes that are more complex it can be useful to explain how the contractor’s access will work during construction and show how the phasing avoids compromising the final design (working with existing site constraints and opportunities).¹

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### (Table 3.2) Site Plan

<table>
<thead>
<tr>
<th>Enhancing the character of the site</th>
<th>Working with existing site constraints and opportunities</th>
<th>Strategic site organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does the design foster a sense of place?</td>
<td>• How well does the design deal with site specific constraints and opportunities?</td>
<td>• Are the buildings, grounds and facilities arranged well on the site?</td>
</tr>
<tr>
<td>• How does the scheme enhance the topography and existing landscape features?</td>
<td>• If the scheme is a refurbishment, what is the rationale for the retention of any existing buildings?</td>
<td>• Does the configuration of buildings create positive internal and external spaces?</td>
</tr>
<tr>
<td>• How does the scheme enhance the micro-climate and ecology of the site?</td>
<td>• How has the design responded to the acoustic constraints of the site?</td>
<td>• Are the external circulation routes clear and do they balance the needs of different users?</td>
</tr>
<tr>
<td>• Does the scheme make the most of its position and views?</td>
<td>• Does the proposed phasing work sensibly without compromising the final design?</td>
<td>• Does the scheme relate well to buildings outside the site?</td>
</tr>
<tr>
<td>• Does the scheme relate well to buildings outside the site?</td>
<td>• Does the phasing allow the school to function during the construction period?</td>
<td></td>
</tr>
<tr>
<td>• Does the scheme provide shelter from the prevailing wind, rain and sun?</td>
<td>• Does the scheme approach existing services and utilities sensibly?</td>
<td>• Does the scheme approach existing services and utilities sensibly?</td>
</tr>
<tr>
<td></td>
<td>• Are there specific site issues that infringe on the site of the school buildings?</td>
<td>• Are there discrete arrangements for deliveries and refuse collection?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Are routes to sports facilities safe throughout the year?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Is any car parking on the site unobtrusive?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How does the scheme create identifiable boundaries and security zones?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Have sensible routes to key areas of the grounds been planned to avoid disruption to learning spaces?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Do the entrance routes to the school link to local movement routes?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Are the buildings placed to achieve optimum orientation? Does the strategic vision for the site allow for future development?</td>
</tr>
</tbody>
</table>

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1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/site-plan-questions , Accessed (2008).
3. School Grounds

Making assets of the outdoor spaces

“The amount of recommended space for outdoor activity/play can vary significantly. It is best to provide at least the minimum required space, rather than no outside space at all. Compensation for lack of outdoor space with additional indoor activity space, in equal proportion to the outdoor requirement, is acceptable.

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1 Alan ford, (2007), Desining the Sustainable School: The Images publishing group.
Given the constraints of building sites, particularly in urban or inner-city locations, outdoor space may not be possible. In such situations, designers must find inventive solutions for access to fresh air and sunlight. Any outdoor space, however small, can be important, providing release to the students, and offering a broad range of educational opportunities, even if not satisfying requirements for an outdoor area.”

The outdoor theatre space, which is adjacent to drama, also provides an informal social space for students (outdoor learning and social spaces and play).

Learning is about creating connections between students directly with the environment in which they live. The central courtyards expose students to art.

The school expands beyond the classroom by connecting the district’s educational pedagogy with environmental sustainability.

The clear organization of the different functions suggests that the grounds would be memorable and change with the seasons.
## Table 3.3) School Grounds

<table>
<thead>
<tr>
<th>Relationship between the grounds and the buildings</th>
<th>Social spaces and play</th>
<th>Outdoor learning</th>
<th>Physical activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Relationship between the grounds and the buildings</td>
<td>• Are outdoor spaces provided for a variety of different student social activities, interest ranges and group sizes?</td>
<td>• Are there provisions for outdoor learning?</td>
<td>• Are there opportunities for a wide range of physical activities?</td>
</tr>
<tr>
<td>• Do the grounds and planting contribute to creating a sense of place?</td>
<td>• Are there spaces which allow imaginative and creative play?</td>
<td>• How do the outdoor learning spaces support the curriculum?</td>
<td>• Are there opportunities for challenge and risk taking in the grounds?</td>
</tr>
<tr>
<td>• Does the design respond to the existing topography, climate and ecology of the site?</td>
<td>• Are some social spaces sheltered from wind, rain and sun?</td>
<td>• How do the learning spaces support the school's pedagogy?</td>
<td>• Are sports facilities integrated into the overall landscape strategy?</td>
</tr>
<tr>
<td>• Have the outside spaces been designed in conjunction with the building form?</td>
<td>• Are social spaces safe?</td>
<td>• Are there clear links between the indoor and outdoor learning environments?</td>
<td>• Does the design maximize the area for sports pitches?</td>
</tr>
<tr>
<td>• Is there strong structural planting with a coherent hierarchy?</td>
<td>• Does the design provide outdoor dining both formally and informally?</td>
<td>• Can food be grown in the grounds?</td>
<td>• Has access to other local facilities been considered?</td>
</tr>
<tr>
<td>• Do the grounds support a sustainability strategy?</td>
<td>• Is external seating and storage provided?</td>
<td></td>
<td>• Do the grounds facilitate community use?</td>
</tr>
<tr>
<td>• Does the scheme provide a rich sensory environment?</td>
<td></td>
<td></td>
<td>• Can the areas for physical activity be easily used during the winter months?</td>
</tr>
<tr>
<td>• Will the school grounds change with the seasons?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Does the planting enhance the micro-climate to create habitable spaces?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Have the maintenance and management implications of the design been considered?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Are there views out over the surrounding landscape?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Are external shelters well-incorporated with the design to provide robust and practical transitions?</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/school-grounds-questions, Accessed (2008).
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Figure 3. 12 Secondary School in Hong Kong has an excellent reputation in sports facilities. “www.wan.com”

Figure 3. 13 Choueifat secondary It’s considered a physical space for sports.”Researcher”.

Figure 3. 14 Social spaces and play spaces are between the school spaces. “http://www.cabe.org.uk/design-review/schools/site-plan”.

Figure 3. 15 Benjamin franklin school has outdoor learning spaces in courtyards. “Sustainable school book”.¹

¹ Alan ford, (2007), Designing the Sustainable School: The Images publishing group.
4. Organization:

Creating a clear diagram for the buildings

Criteria for good school design accommodating the educational agenda is this successfully accommodated in the internal arrangement of spaces.

Adjacencies between school program elements are determined by the following major factors:

A. Entry sequence: How do students enter school each day, and where do they go? Do they immediately report to a homeroom, or do they first gather in a larger area such as the gym or the cafeteria? How do staff and faculty enter the building? How does the public enter the building during the school day? Is central administration the security check point? How does the public enter the building for community events?

B. Internal circulation: During the school day, where do students have to go, and how often? Do they travel the corridors as a class, such as in secondary school, while

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1 Alan ford, (2007), Desining the Sustainable School: The Images publishing group.
2 Alan ford, (2007), Desining the Sustainable School: The Images publishing group.
other classes are in session? Do they travel individually at each class period, such as in the upper grades? How much time is allotted between periods, and how far are the distances? How are student lockers used and distributed in the school?

Figure 3. 17 Clear circulation and zoning in the design. “Educational Buildings spaces book”

Figure 3. 18 Ground floor plan has clear zoning. “Educational buildings spaces book”.

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### (Table 3.4) Organization

<table>
<thead>
<tr>
<th>Accommodating the educational agenda</th>
<th>Spatial organization</th>
<th>Movement routes</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Is this successfully accommodated in the internal arrangement of spaces?</td>
<td>• Is there a clear spatial diagram for the building?</td>
<td>• Is there a clear hierarchy of circulation routes?</td>
</tr>
<tr>
<td>• Is there a clear understanding of the school’s educational agenda and its organizational implications?</td>
<td>• Are the learning spaces arranged well across the school?</td>
<td>• Are links between indoor and outdoor spaces optimized?</td>
</tr>
<tr>
<td>• Will the design allow the delivery of the curriculum when the school opens?</td>
<td>• Does the design provide opportunities for cross-curricular learning?</td>
<td>• Is there a clear movement and connection diagram?</td>
</tr>
<tr>
<td>• What are the aspirations of the pastoral system?</td>
<td>• Is there a diagram showing which of the spaces will be timetabled?</td>
<td>• Is there a variety of circulation spaces which respond intelligently to any changes in level?</td>
</tr>
<tr>
<td>• Does the design identify the main social spaces?</td>
<td>• Does the spatial arrangement allow for natural ventilation and day lighting to the majority of spaces?</td>
<td>• Has the vertical circulation been designed to avoid congestion and encourage positive behavior?</td>
</tr>
<tr>
<td>• What is the role of ICT in the educational agenda?</td>
<td>• Does the location on specialist facilities allow the design to accommodate different pedagogies?</td>
<td>• Do movement routes into the school depend on signage?</td>
</tr>
<tr>
<td>• How does the design encourage a healthy food agenda?</td>
<td>• Is the plan legible for users?</td>
<td>• Can vertical and horizontal links be made between clusters?</td>
</tr>
</tbody>
</table>

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1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/organisation-questions, Accessed (2008).
5. Building and Form

Making form, massing and appearance work together

Case study: The sketch felt this is a highly competent scheme. The building’s rational diagram generates clear entrances, a legible internal environment and an inherent flexibility and adaptability for the future.

Diagrams explain how the ‘schools within schools’ pedagogy is translated into the design (concept). The scheme creates a relationship with the existing primary school opposite by establishing a ‘learning plaza’ between the two (form and massing).
### (Table 3.5) Buildings

<table>
<thead>
<tr>
<th>Concept</th>
<th>Form and massing</th>
<th>Appearance</th>
<th>Construction and materials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is there a coherent design idea that relates plans, sections and elevations?</td>
<td>Are the building’s form and massing appropriate to the site?</td>
<td>Do the elevations reflect the design concept to create an inspiring building?</td>
<td>Do the materials contribute positively to the quality of the scheme?</td>
</tr>
<tr>
<td>Has the organization diagram been convincingly translated into a coherent building?</td>
<td>Does the building create well proportioned internal and external spaces?</td>
<td>Is the building good architecture in its own right?</td>
<td>Will the fabric of the buildings be durable and easy to maintain?</td>
</tr>
<tr>
<td>In refurbishment schemes, do the new elements relate well to existing buildings and make the school into a coherent whole?</td>
<td>How does the massing support the day lighting strategy?</td>
<td>How is the spatial organization of the school expressed in the elevations?</td>
<td>Which details give the design value?</td>
</tr>
<tr>
<td></td>
<td>Has the height of the building been considered from educational and massing perspectives?</td>
<td>How any is exposed structure detailed?</td>
<td>Are any modern methods of construction used?</td>
</tr>
<tr>
<td></td>
<td>How do the buildings on the site relate to one another?</td>
<td>How is the fenestration designed and detailed?</td>
<td>Has the maintenance strategy been addressed?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>How have the entrances been defined through the building design?</td>
<td>How do the materials contribute to the character of the scheme?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Does the roof plan support the resources strategy?</td>
<td>How do the materials used support the sustainability strategy?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is there elevation co-ordination of services and lighting?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>How do the elevations respond to orientation and site constraints?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>How do the elevation help deliver a low-energy internal environment?</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>How are color, pattern, graphics and texture integrated?</td>
<td></td>
</tr>
</tbody>
</table>

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1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/buildings-questions, Accessed (2008).
6. Interiors

Will the building work well in full use?

Have the acoustic requirements of different spaces been achieved?

Figure 3.22 Section “http://www.cabe.org.uk/design-review/schools/interiors-questions”.

Orestad College:

Figure 3.23 Entrance lobby. www.conceptrends.com.
Figure 3.24 Mezzanine floor. www.conceptrends.com.
Figure 3.25 Dining Area. www.conceptrends.com.

The main stair case is the heart of college educational and social life; the primary connection up and down, but also a place to stay, watch and be seen. Three ‘mega columns’ form the primary load bearing system, supplemented by a number of smaller columns positioned according to structural requirement, not as part of a regular grid.¹

### (Table 3.6) Interiors

<table>
<thead>
<tr>
<th>Variety and delight</th>
<th>High quality</th>
<th>The building in use</th>
</tr>
</thead>
<tbody>
<tr>
<td>Will occupants experience variety and delight as they move around the school?</td>
<td>Will the internal environment help students and staff feel valued and motivated?</td>
<td>Will the building work well in full use?</td>
</tr>
<tr>
<td>Are circulation and social areas inviting to students?</td>
<td>Are learning spaces well proportioned and pleasant?</td>
<td>Have the acoustic requirements of different spaces been dealt with?</td>
</tr>
<tr>
<td>How will the school stamp its identity on the building?</td>
<td>Does the quality of the space encourage good behavior?</td>
<td>Is the ability to display students' work incorporated into the design?</td>
</tr>
<tr>
<td>Is there a well considered strategy for the use of color, pattern, graphics and texture?</td>
<td>Are internal materials demonstrably robust?</td>
<td>Are the acoustics appropriate in all spaces not just the classrooms?</td>
</tr>
<tr>
<td>Is dining seen as a social activity?</td>
<td>Will the users be aware of the external environment throughout the day?</td>
<td>Does the building enable staff to respond to the differing needs of the range of age groups?</td>
</tr>
<tr>
<td>Do circulation and social spaces benefit from daylight and views?</td>
<td>Is the furniture of high quality and robust?</td>
<td>Will there be glimpses of the range of learning activities happening in the school to inspire pupils?</td>
</tr>
<tr>
<td></td>
<td>Is the incorporation of storage well-considered?</td>
<td>Will the use of outdoor courtyards cause disturbance to adjacent class spaces?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Is staff offered a good working environment?</td>
</tr>
</tbody>
</table>

---

1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: [http://www.cabe.org.uk/design-review/schools/interiors-questions](http://www.cabe.org.uk/design-review/schools/interiors-questions), Accessed (2008).
7. Resources:

Deploying convincing environmental strategies

Prevailing winds at Salana pacific school, the school is oriented to Prevailing wind and solar access, taking advantage of prevailing breezes for natural cooling, solar gain for heating and proper protection through shading. “Educational facilities book” 1.

Figure 3. 28 Salana pacific school. “Educational facilities book” 2.

Figure 3. 29 Hector Garcia school-The direct and indirect sun at north and south elevation.

“Educational facilities book” 3.

---

### Table 3.7: Resources

<table>
<thead>
<tr>
<th>Orientation</th>
<th>Ventilation</th>
<th>Day lighting</th>
<th>Energy and services strategies</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Has the optimum orientation for different types of spaces been considered?</td>
<td>• Does the ventilation strategy provide a comfortable environment in which to learn in all seasons?</td>
<td>• Is key spaces daylight for most of the year?</td>
<td>• Does the whole design help to minimize energy use and carbon emissions?</td>
</tr>
<tr>
<td>• Does the design of the elevations respond to different orientations?</td>
<td>• Where possible, are spaces naturally ventilated?</td>
<td>• Are solar glare and solar gain well controlled?</td>
<td>• Is any on-site energy generation appropriate and meaningful?</td>
</tr>
<tr>
<td>• Does the building form allow daylight into all spaces?</td>
<td>• Are mixed mode systems proposed? If so, where and why?</td>
<td>• Are opportunities for roof-lights utilized?</td>
<td>• Will the design provide an environment with a comfortable temperature for learning throughout the year?</td>
</tr>
<tr>
<td>• Do the room proportions allow good daylight and ventilation?</td>
<td>• Is ventilation maintained when blinds are in use?</td>
<td>• Are halls and circulation areas well day-lit?</td>
<td>• How can CO2 emissions and water saving be used in the curriculum and community engagement?</td>
</tr>
<tr>
<td>• Has the orientation informed the choice of materials or detailing of elevations?</td>
<td>• How, if applicable, is night time ventilation achieved securely?</td>
<td>• How is summer time overheating avoided?</td>
<td>• How, if applicable, will biomass be delivered and handled?</td>
</tr>
<tr>
<td></td>
<td>• Is the environmental strategy resilient to increased heat gain or the effects of climate change?</td>
<td>• Are the effects of external noise dealt with?</td>
<td>• How is waste reduction approached on a whole life basis?</td>
</tr>
<tr>
<td></td>
<td>• How is the ventilation controlled, especially in the design of window openings?</td>
<td>• How is the ventilation controlled, especially in the design of window openings?</td>
<td>• Is there a clear strategy for reduction of energy use and CO2 emissions?</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• How will the ventilation strategy function if different plan layouts or pedagogies are adopted?</td>
<td>• How are energy, water and waste minimized, particularly from out of hours and equipment use?</td>
</tr>
</tbody>
</table>

---

1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/resources-questions, Accessed (2008).
8. Feeling Safe

Creating a secure and welcoming place safe: creating a secure and welcoming place.

<table>
<thead>
<tr>
<th>(Table 3.8) Feeling Safe(^1)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>External environment</strong></td>
</tr>
<tr>
<td>• Are external routes and boundaries clear and well defined?</td>
</tr>
<tr>
<td>• Is the security strategy balanced with openness?</td>
</tr>
<tr>
<td>• Can all users access the site safely?</td>
</tr>
<tr>
<td>• Is it clear which areas are open to the community and which are not?</td>
</tr>
<tr>
<td>• How does the boundary treatment facilitate the school’s approach to security?</td>
</tr>
<tr>
<td>• Are entrances welcoming for all users of the building, well located and capable of passive surveillance?</td>
</tr>
<tr>
<td>• Can boundaries between zones change to suit activities?</td>
</tr>
<tr>
<td>• Are pedestrian routes overlooked and safe throughout the day and evenings?</td>
</tr>
<tr>
<td>• Are teachers' work rooms and administration staff’s offices in key positions for overlooking?</td>
</tr>
</tbody>
</table>

Feeling safe by looking at the plans and drawings presented to the schools design panel.

“The design creates a secure and welcoming environment both internally and externally on a tight inner city site. It creates clear boundaries and uses passive supervision successfully throughout the buildings”\(^2\)

---

\(^1\) John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available : http://www.cabe.org.uk/design-review/schools/feeling-safe-questions, Accessed (2008).

Floor plans

“Boundaries are clearly defined on the plan. The visitor and student entrances are welcoming and well-located, with a prominent reception desk. The service yard is discretely positioned and is tightly controlled, providing limited access to the site (external environment). The staff admin offices are positioned at the entrances to the teaching wings and the main staff room overlooks the social space in the south courtyard with the Learning Resource Centre overlooking the Northern courtyard.

The corridors have clear views out and in. The design also allows easy community use of the theatre and sports hall, so that only the west building areas remain open out of hours”.

1 John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Avilable : http://www.cabe.org.uk/design-review/schools/feeling-safe-questions, Accessed (2008).
9. Long Life, Loose Fit: Creating a school that can adapt and evolve in the future

The designer is able to add value by designing schools that are adaptable to future changes of use while being cost-effective to build and maintain. The designer advice on how all areas of the building program can be optimized to ensure the project is completed on time and to budget. To deliver economical and future-proof solutions The designer consider key aspects such as flexibility of space planning and accessible primary services distribution, the standardization of structural elements, use of off-site prefabrication, and the future integration of ICT connectivity. We always aim to ensure that work is completed with as little disruption to the students as possible.

<table>
<thead>
<tr>
<th>Day to day flexibility</th>
<th>Adaptability</th>
<th>Furniture &amp; equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Does the design provide day to day flexibility for different types of learning and teaching?</td>
<td>• Is the building able to accommodate different organizational structures or pedagogies over time?</td>
<td>• Can a good range of layouts be made using the proposed furniture?</td>
</tr>
<tr>
<td>• Is there a range of spaces available for widely different group sizes?</td>
<td>• How well does the design allow for future expansion of the school?</td>
<td>• Will the proposed furniture and equipment allow changes to be made easily?</td>
</tr>
<tr>
<td>• Does the design encourage social learning throughout the school and its grounds?</td>
<td>• What impact will alternative layouts have on the circulation?</td>
<td>• Where will furniture be stored when not in use?</td>
</tr>
<tr>
<td>• Can spaces be reconfigured easily?</td>
<td>• Which pastoral / curriculum groupings can the plan accommodate?</td>
<td>• How will the furniture and equipment be integrated with ICT?</td>
</tr>
<tr>
<td>• How does the design support community use and out of hours use?</td>
<td>• Do the building services allow for adaptation of the plan?</td>
<td>• Is there a variety of furniture provided?</td>
</tr>
<tr>
<td>• Are the spaces suitable for a variety of uses?</td>
<td>• If the layout changes, what will be the impact on the day lighting of the space? On acoustics? On ICT?</td>
<td>• What external furniture will be provided?</td>
</tr>
</tbody>
</table>

**Example plan:** The plan is a refurbishment and extension of an existing building which radically changes the school through the new circulation street which connects the general and specialist learning spaces to the social areas. The plan also adds extra classrooms to the existing blocks creating clusters with central open plan spaces. This was commended as an approach which offers flexibility of organization. The plan provides various degrees of enclosure with external learning spaces available. Specialist teaching spaces are on either side of the central generic cluster (day to day flexibility).

![Figure 3.33](https://www.cabe.org.uk) The plan adds extra classrooms to the existing blocks creating clusters with central open plan spaces. “www.cabe.org.uk”

![Figure 3.34](https://www.cabe.org.uk) Cluster floor plans The drawing shows the variety of different layouts the plan can support for different curriculum arrangements. The same furniture is used in each of the layouts, presentation and exam scenario. (Adaptability). “www.cabe.org.uk”

---

10. Successful Whole:

(Table3.10) Successful Whole - questions to ask\(^1\)

<table>
<thead>
<tr>
<th>Appropriateness</th>
<th>Delight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does this design as a whole offer a thoughtful, coherent and convincing response</td>
<td>Will it be a pleasure to work, eat, learn, play, teach and socialize in this school?</td>
</tr>
<tr>
<td>to the key issues of the site and brief?</td>
<td></td>
</tr>
<tr>
<td>Does the whole design add up to more than a sum of its parts?</td>
<td></td>
</tr>
</tbody>
</table>

**Timelessness**

<table>
<thead>
<tr>
<th>Fulfilling user intentions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is this school set to become a cherished part of its locality?</td>
</tr>
<tr>
<td>Does the architectural approach successfully meet the aspirations of the client and community?</td>
</tr>
<tr>
<td>Will the school’s design help to deliver educational transformation?</td>
</tr>
</tbody>
</table>

**Example plan:** The CABE commented that this plan has great overall potential. It resolves the difficult problem of tying three schools together coherently across the campus without compromising the schools’ desire to retain separate identities. The scheme was also commended for its straightforward approach to organization which creates legible circulation routes throughout the building.

![Lower ground floor plan](http://www.cabe.org.uk/design-review/schools/successful-whole)

Figure 3. 35 Lower ground floor plan-The plan provides a variety of spaces inside and out with main social spaces in the heart of the school. “http://www.cabe.org.uk/design-review/schools/successful-whole”.

---

\(^1\) John Sorrell CBE Chair, (2007), Commission for Architecture and the Built Environment This final version of our website was archived on, Available: http://www.cabe.org.uk/design-review/schools/successful-whole, Accessed (2008).
Figure 3. 36 plan is for the 3 schools. “www.cabe.org.uk”.

Figure 3. 37 plan for classrooms. “http://www.cabe.org.uk/design-review/schools/successful-whole”.
Chapter Three  
Design Criteria of Sustainable School

Figure 3. 38 back of house area “http://www.cabe.org.uk/design-review/schools/successful-whole”.

Figure 3. 39 Administration “http://www.cabe.org.uk/design-review/schools/successful-whole”.

Figure 3. 40 plan is for sports and performance open zone theater & Foyer “http://www.cabe.org.uk/design-review/schools/successful-whole”.
Figure 3.41 Perspective from grounds-The scheme makes good use of its position giving views out across the landscape from the learning spaces (appropriateness). The three schools which make up the brief are carefully integrated yet retain their identities. “http://www.cabe.org.uk/design-review/schools/successful-whole (Accessed 2008)”.

Figure 3.42 south west elevation. “http://www.cabe.org.uk/design-review/schools/successful-whole (Accessed 2008)”.

Figure 3.43 south east elevation. “http://www.cabe.org.uk/design-review/schools/successful-whole”.

Figure 3.44 north west elevation. “http://www.cabe.org.uk/design-review/schools/successful-whole”.

Figure 3.45 north east elevation. “http://www.cabe.org.uk/design-review/schools/successful-whole”.
The topography of the site is well considered with the scheme dealing successfully with changes in level when locating the playing fields and entrances to the site (appropriateness).

Figure 3.46 Perspective of entrance approach
The perspective shows the clear entrance route to the building and access points for inclusion and the community. “http://www.cabe.org.uk/design-review/schools/successful-whole”.

3.3 LEED for Schools

"Green schools create healthy environments conducive to learning while saving energy, resources, and money. The U.S. Green Building Council (USGBC) developed The Green Existing Schools Project Management Guide to help schools and school districts green their existing facilities and achieve LEED (Leadership in Energy and Environmental Design) certification. The guide outlines the process for navigating LEED certification for existing schools and provides details on how to conduct organizational assessments, educate and train staff, initiate the certification process, and manage a campus- or district-wide plan.

USGBC works toward its mission of market transformation through its LEED green building certification program, robust educational offerings, a nationwide network of chapters and affiliates, the annual Green build International Conference & Expo, and advocacy in support of public policy that encourages and enables green buildings and communities."  

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1 The U.S. Green Building Council is a Washington, D.C.-based 501(c) (3) nonprofit organization committed to a prosperous and sustainable future for our nation through cost-efficient and energy-saving green buildings.
3.3.1 What is LEED?

In 2000, USGBC established the LEED rating system as a way to define and measure “green & Sustainable buildings.” LEED is an internationally recognized green building certification system, providing third-party verification that measures how well a building or community performs across all the metrics that matter most: energy savings, water efficiency, CO2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. The suite of LEED rating systems are designed to address the complete lifecycle of buildings.

Each rating system provides a concise framework for identifying and implementing practical and measurable green building solutions. LEED points are awarded on a 100-point scale, and credits are weighted to reflect their potential environmental impacts. A project must satisfy specific prerequisites and earn a minimum number of points to be certified. Certification levels, based on the number of points, include: Certified, Silver, Gold, and Platinum.

3.3.1.1 LEED for Schools

The LEED for Schools Rating System recognizes the unique nature of the design and construction of K-12 schools. Based on LEED for New Construction, it addresses issues such as classroom acoustics, master planning, mold prevention, and environmental site assessment.

By addressing the uniqueness of school spaces and children’s health issues, LEED for Schools provides a unique, comprehensive tool for schools that wish to build green, with measurable results. LEED for Schools is the recognized third-party standard for high performance schools that is healthy for students, comfortable for teachers, and cost-effective.¹

3.3.2 LEED for Existing Buildings: O&M Rating System Credit Categories

O&M rating system is organized into six credit categories are:

1. Sustainable Sites  
2. Water Efficiency  
3. Energy and Atmosphere  
4. Materials and Resources  
5. Indoor Environmental Quality  

Regional Priority is an additional category that acknowledges the importance of local conditions in determining best practices for ongoing operations and maintenance.

1. Sustainable Sites:

Credits promote responsible, innovative, and practical site maintenance strategies that are sensitive to plants, wildlife, and water and air quality. These credits also mitigate some of the negative effects buildings have on the local and regional environment. Environmentally sensitive site maintenance practices reduce site operations and maintenance costs while creating and maintaining outdoor spaces that are attractive and healthy for both building occupants and local flora and fauna.

<table>
<thead>
<tr>
<th>(Table 3.11) Sustainable Sites Points: (SS)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>• SSc1 LEED Certified Design and Construction</td>
<td>• SSc7.1 Heat Island Reduction—Non roof</td>
<td>• SSc8 Light Pollution Reduction</td>
</tr>
<tr>
<td>• SSc2 Building Exterior and Hard scape Management Plan.</td>
<td>• SSc7.2 Heat Island Reduction—Roof</td>
<td></td>
</tr>
<tr>
<td>• SSc3 Integrated Pest Management, Erosion Control, Landscape Management Plan.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SSc4 Alternative Commuting Transportation.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SSc5 Site Development—Protect or Restore Open Habitat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• SSc6 Storm water Quantity Control</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. Water Efficiency:

Prerequisites and credits encourage the use of strategies and technologies that reduce the amount of potable water consumed in facilities. Many water conservation strategies are no-cost; others provide rapid payback. Some, such as biological wastewater treatment systems and gray water plumbing systems, require more substantial investments and are cost-effective only under certain building and site conditions.¹

<table>
<thead>
<tr>
<th>Water Efficiency Points: (WE)²</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>WEp1</strong> Minimum Indoor Plumbing Fixture and Fitting Efficiency.</td>
</tr>
<tr>
<td><strong>WEc1</strong> Water Performance Measurement</td>
</tr>
<tr>
<td><strong>WEc2</strong> Additional Indoor Plumbing Fixture and Fitting Efficiency</td>
</tr>
<tr>
<td><strong>WEc3</strong> Water Efficient Landscaping</td>
</tr>
<tr>
<td><strong>WEc4</strong> Cooling Tower Water Management.</td>
</tr>
</tbody>
</table>

3. Energy and Atmosphere: Prerequisites and credits address the reduction of energy consumption through a performance-based approach that allows owners and managers to tailor energy reduction measures to their buildings. Improving the energy performance of facilities lowers operating costs, reduces pollution, and enhances occupant comfort. Many energy efficiency measures have a rapid payback because of the rising cost of energy.³

<table>
<thead>
<tr>
<th>Energy and Atmosphere points: (EA)⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>EAp2</strong> Minimum Energy Efficiency Performance</td>
</tr>
<tr>
<td><strong>EAp3</strong> Fundamental Refrigerant Management</td>
</tr>
<tr>
<td><strong>EAc1</strong> Optimize Energy Efficiency Performance</td>
</tr>
<tr>
<td><strong>EAc2.1</strong> Existing Building Commissioning—Investigation and Analysis</td>
</tr>
<tr>
<td><strong>EAc2.2</strong> Existing Building Commissioning—Implementation</td>
</tr>
<tr>
<td><strong>EAc2.3</strong> Existing Building Commissioning—Ongoing Commissioning</td>
</tr>
<tr>
<td><strong>EAc3.1</strong> Performance Measurement—Building Automation System</td>
</tr>
<tr>
<td><strong>EAc3.2</strong> Performance Measurement—System-Level Metering</td>
</tr>
<tr>
<td><strong>EAc4</strong> On-site and Off-site Renewable Energy</td>
</tr>
<tr>
<td><strong>EAc5</strong> Enhanced Refrigerant Management</td>
</tr>
<tr>
<td><strong>EAc6</strong> Emissions Reduction Reporting</td>
</tr>
</tbody>
</table>

4. Materials and Resources:

Prerequisites and credits set the foundation for developing, implementing, and documenting policies and practices that support effective waste management and responsible procurement. The MR credit category focuses on two main issues: the environmental impact of materials brought into the facility and the minimization of landfill and incinerator disposal for materials taken out of the facility.  

<table>
<thead>
<tr>
<th>(Table 3.14) Materials and Resources Points: (MR) ²</th>
</tr>
</thead>
<tbody>
<tr>
<td>• MRp1 Sustainable Purchasing Policy.</td>
</tr>
<tr>
<td>• MRp2 Solid Waste Management Policy.</td>
</tr>
<tr>
<td>• MRc1 Sustainable Purchasing—Ongoing Consumables.</td>
</tr>
<tr>
<td>• MRc2 Sustainable Purchasing—Durable Goods.</td>
</tr>
<tr>
<td>• MRc3 Sustainable Purchasing—Facility Alterations and Additions</td>
</tr>
<tr>
<td>• MRc4 Sustainable Purchasing—Reduced Mercury in Lamps.</td>
</tr>
<tr>
<td>• MRc5 Sustainable Purchasing—Food.</td>
</tr>
<tr>
<td>• MRc6 Solid Waste Management—Waste Stream Audit</td>
</tr>
<tr>
<td>• MRc7 Solid Waste Management—Ongoing Consumables</td>
</tr>
<tr>
<td>• MRc8 Solid Waste Management—Durable Goods</td>
</tr>
<tr>
<td>• MRc9 Solid Waste Management—Facility Alterations and Additions</td>
</tr>
</tbody>
</table>

5. Indoor Environmental Quality:

Prerequisites and credits address concerns relating to indoor air quality; occupant’s health, safety, and comfort; air change effectiveness; and air contaminant management. The IEQ credit category encourages improvements to ventilation, indoor CO2 levels, day lighting and lighting quality, and thermal comfort – all of which have the potential to impact occupant health and performance.  

---

6. Innovation in Operations:

Credits recognize projects for innovative and exemplary technologies, methods, project planning, and project execution.

**Regional Priority (RP)** credits address environmental concerns that are local priorities for each region of the country, as identified by USGBC’s regional councils, chapters, and affiliates. A project that earns a regional priority credit will earn one bonus point in addition to any points already awarded for that credit. Up to four extra points can be earned in this way. 

---

The School as a Teaching Tool

Teachers at green schools can use the building as the basis for innovative curricula. The school can serve as a tool for hands-on lessons, such as math students tracking and charting utility cost savings, science students analyzing the environmental impact of traditional cleaning products compared to eco-friendly ones, and students designing their dream sustainable homes using the types of systems and innovations used to green their school. Exercises like these help students connect to their environment and understand the effect that buildings have on land, natural resources, and their communities.

Green Schools at the Intersection of “Big Three”: Energy, Education, and Health

Green schools are at the very intersection as healthy environments conducive to learning while saving energy and money.

Education: With reduced operating costs, green schools can put the money saved directly back into the classroom. Innovative design strategies provide students and teachers with a wealth of hands-on learning opportunities that they can take beyond the classroom and into their homes and communities. Young people are at the forefront of the fight against climate change, and they understand what is at stake if significant efforts are not made to rethink the way America produces and uses energy. We must recognize the need to meet the demands of this new generation of sustainability natives, and to prepare them for the emerging green jobs market.

When it comes to educating for sustainability, teachers are seeking interdisciplinary, active models of student engagement that are easily applied to their classrooms. The approach must be both informational and interactive: learned and experienced. Utilizing the built environment as the context for learning promotes student achievement in math, science, and literacy skills through hands-on
explorations. Envision students engaged with a new type of laboratory – their immediate surroundings – exploring concepts and developing new understandings.¹

### 3.3.3 West Brazos Junior High School

**A Better Learning Environment**

Architect: SHW Group, LLP  
School on the Texas Gulf Coast Shows a Cost-Effective Approach to Green

**Project Size:** 91,500 square feet  
**Total Project Cost:** $9,931,000  
**Cost per square foot:** $109

**PROJECT BACKGROUND²**

West Brazos Junior High School, located in Brazoria, Texas, serves 600 students in grades seven and eight. The first public junior high school in Texas to earn LEED certification, West Brazos opened in time for classes in fall 2006. Built for $109 per square foot, the school was built for 18% less than the average junior high school in the region.³

**LEED Facts**

“Our goal was to demonstrate that green schools were achievable without spending extra money during the process. The key was smarter choices, not more money.”⁴ Martha Buckner, Assistant Superintendent, Columbia Brazoria Independent School District.

<table>
<thead>
<tr>
<th>West Brazos Junior High School Brazoria, Texas</th>
<th>LEED for New Construction Certification awarded July 30, 2007 Certified 27*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustainable Sites</td>
<td>7/14</td>
</tr>
<tr>
<td>Water Efficiency</td>
<td>4/5</td>
</tr>
<tr>
<td>Energy &amp; Atmosphere</td>
<td>1/17</td>
</tr>
<tr>
<td>Materials &amp; Resources</td>
<td>4/13</td>
</tr>
<tr>
<td>Indoor Environmental Quality</td>
<td>6/15</td>
</tr>
<tr>
<td>Innovation &amp; Design</td>
<td>5/5</td>
</tr>
</tbody>
</table>

*Out of a possible 69 points  
(Table 3.17)

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² http://www.dbrrinc.com/featured/West_Brazos_Junior_High_School  
⁴ http://www.greenschoolbuildings.org/resources.aspx
1. Sustainable Sites

The beautifully wooded site is approximately 57 miles (92 kilometers) south of Houston. This regional focus gave the community a brand-new green school with a similar aesthetic to conventionally designed schools in the area – something the community

Figure 3. 47-Aluminum shading outside the building reduces heat load on the windows, minimizing cooling needs inside, and the shades were “low-cost items that get big gains” financially, according to Henry. “Available: www.greenrightnow.com (Accessed 2009)”.

Figure 3. 48 Library has visual link to the exterior spaces “Available: www.greenrightnow.com (Accessed 2009)”.

Figure 3. 49 site plan. “Sustainable School Book”.

Figure 3. 50 Main Entrance. “Available: www.greenrightnow.com (Accessed 2009)”.
values.

The building is located on a 53-acre site landscaped with vegetation that is adapted to the region’s coastal environment and needs no irrigation.

To encourage alternative transportation, the school provides bike racks and showers, preferred parking spaces for carpool vehicles and a carpool incentive program.¹

![The school building’s dominant material is concrete masonry, which was chosen for its natural, durable quality. "Available:www.schooldesigns.com (Accessed 2009)”.](image)

2. Water Efficiency

School is succeeded in Storm water management. The site is preserved and consists of rainwater detention and natural filtration areas, and naturally preserved native landscape. All landscape elements added to the site, including spaces adjacent to the building, are filled with native grasses, bushes, and trees that are drought-resistant and thrive in the regional coastal environment.

Low-flow toilets and faucets reduce the project’s interior water use, bringing total potable water consumption 31.31% below code.

All drains from custodial rooms and science areas are separately plumbed.

3. Energy & Atmosphere

Core spaces (library, dining area and group instructions spaces) are also daylight, reducing artificial lighting loads, providing a visual link to the exterior spaces, reducing costly energy demands, lowering life cycle cost, and ensuring that the students and teachers can learn, work, and play in an open, fun, and liberating environment.¹

Heat island effects are reduced through the use of a high-reflective Energy Star roofing system and reflective paving, which also reduce heat gains.

4. Materials & Resources

The school is low emitting materials, it’s used local materials, and 14.17 recycled materials, recycled 99.95 of construction waste.

The building is primarily concrete masonry and includes stucco and metal panels. The project team selected these materials for their durability and low maintenance needs as well as their cost and aesthetics. The team also selected materials for their recycled content and regional origins. More than 55% of all materials, by cost, were manufactured within 500 miles of the project site, and the construction team diverted 56% of all waste, by weight, from the landfill.²

The project team selected adhesives, sealants, paints, and carpeting for their low chemical emissions. Entry grates collect dirt and other pollutants before occupants track them into the building.

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¹ Alan ford, (2007), Desining the Sustainable School: The Images publishing group.
² U.S. Green Building Council, (2008), Printed on 100% post consumer recycled, process chlorine-free paper with non-toxic soy inks
All roofing materials and site paving are light-colored; reducing the project’s contribution to the urban heat-island effect, and all site lighting was selected or modified to reduce light pollution.¹

Figure 3. 52 Interior spaces at the school have light colored finishes to accent natural lighting. “Available:www.greenrightnow.com (Accessed 2009”).

5. Indoor Environmental Quality

The school has committed to preserving indoor environmental quality by using only green cleaning products.

All custodial rooms, science labs and copy areas feature dedicated ventilation.²

Low-emissivity glazing in the classrooms, library, cafeteria, and office areas reduce the building’s cooling loads while allowing daylight into working areas.

¹ U.S. Green Building Council, (2008),Printed on 100% post consumer recycled, process chlorine-free paper with non-toxic soy inks

² U.S. Green Building Council, (2008),Printed on 100% post consumer recycled, process chlorine-free paper with non-toxic soy inks
Simple exterior shading devices reduce glare and solar heat gain. They also function as light shelves, bouncing daylight deeper into classroom spaces.

6. Innovation & Design
DESIGNED FOR LEARNING

A 260-foot (79-meter) circulation spine connects multiple learning/activity pod centers. These centers feature clerestory windows, allowing natural light deep into the core spaces.

Encouraged by the links between the indoor environment and student performance, the project team focused on strategies that would enhance day lighting and indoor air quality.

Following the move to the new school, student standardized test scores improved by four, five, and seven percentage points for mathematics, reading, and social studies, respectively.

While privacy and security concerns convinced the project team to leave certain Spaces—including the computer labs, fitness center, and teachers’ lounge without direct outdoor views, windows and clerestories bring daylight into other areas. More than 90% of these remaining areas, including classrooms, have views to the outdoors.

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1 Alan Ford, (2007), Designing the Sustainable School: The Images Publishing Group.
The school Certified under the LEED for New Construction Rating System, the project team achieved Innovation & Design credits by implementing educational signage throughout the building. By working together with the community, the West Brazos Junior High School project team made smart design choices to build a green school in Brazoria, Texas for 18% less than the average cost of school construction for that region.¹

Figure 3. 56 foot circulation spine connects multiple learning/activity pod centers that feature clerestory windows, allowing natural light to penetrate deep into the core spaces. “Available: www.schooldesigns.com (Accessed 2009)”.  

Figure 3. 57 the school improvements in standardized test scores for reading, math and social studies ranged from 4-7% better in the first year alone. “Available: www.usgbc.org(Accessed 2009)”. 

Figure 3. 58 West Brazos Junior High School Ground floor plan.”Researcher”.²


² Alan ford, (2007), Designing the Sustainable School: The Images publishing group.
Conclusion

Diagram 3. 3 sustainable school. “Researcher”

Diagram 3. 4CABE sustainable school. “Researcher”
### 1. Identity & context
![Diagram]

### 2. Site plan
![Diagram]

### 3. School ground
![Diagram]

### 4. Organization
![Diagram]

### 5. Buildings
![Diagram]

### 6. Interiors
![Diagram]

### 7. Resource
![Diagram]

### 8. Feeling safe
![Diagram]

### 9. Long life, loose fit
![Diagram]

### 10. Successful whole
![Diagram]
Chapter Four

International Schools

Case Studies
Chapter Four: International Schools Case Studies

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International Schools Case Studies

This Chapter will present the analysis done by CABE and LEED to international schools, which acquired the certification for sustainability. These selected schools interact with community, and apply sustainable energy. One of these schools is "Stanley park high school, UK". This school is an old school and developed by to be a sustainable building.

This Chapter will present two new sustainable schools in the USA as references which are "Fossil Ridge High School" and "Science Park High School". These American schools are considered successful sustainable examples and were certificated from LEED; the research will also introduce the 10 criteria points of "CABE".

Applications of The 10 Assessment Criteria of CABE

"The following 10 points are the criteria against which each design is assessed.

1. Identity and Context: making a school the students and community can be proud of.
2. Site Plan: making the best use of the site.
4. Organization: creating a clear diagram for the buildings.
7. Resources: deploying convincing environmental strategies.
8. Feeling safe: creating a secure and welcoming place.
9. Long life, Loose fit: creating a school that can adapt and evolve in the future.
10. Successful whole: making a design that works in the round.

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1 CABE, 10 criteria for successful school design, (CABE website archive), Available:www.cabe.org.uk/design-review/schools/criteria (Accessed: 2009, April)
“The sub points are indicators of the success of a design and are the primary issues considered by the panel when scoring a scheme in relation to each of the criteria.”

4.1 Stanley Park High School

4.1.1 Identity and Context

New building in a rural conservation site

This new-built school in a rural setting had its own set of challenges. Its location in a strategic view on an important nature conservation site had a fundamental impact on the design. The site itself is an existing Primary care trust campus due for demolition. The mainstream School and autistic spectrum disorder unit are co-located on the site, allowing independent and shared uses of internal and external spaces.

Key objectives were to create adaptable room configurations, respond to the ‘schools within a school’ vision but with a single school ethos, and provide flexible spaces for team teaching. The surrounding landscape is used as an important learning resource. The local community will be able to use sports facilities out of school hours and the location of the library is designed to encourage use both within and outside the normal school day.

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School elements site planning is analyzed in relation to location, height, site topography and planning constraints. Pedestrian routes for students, staff, parents, and the wider community, as well as vehicular access for public transport and minibuses are shown.

Public rights of way are also indicated on the site plan.
Figure 4.5 Proposed context plan. “Available: www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf (Accessed 2007)”.

Figure 4.6 Schools within schools but one school ethos. “Available: www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf (Accessed 2007)”.

Figure 4.7 Campus zones and relationships “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”.

Figure 4.8 Permeable site north to south. www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf.

Figure 4.9 Shop fronts. “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”.
Figure 4.13 demonstrates how the learning model and school ethos have been translated into an education environment. The vision has been defined in terms of curriculum delivery, the relationship of internal and external spaces, and co-location.
4.1.2 Site Plan

The Orchard Hill site provides a unique opportunity to create an exemplar school environment, providing external teaching, social, sports and performance
spaces set within the context of existing mature landscape, whilst ensuring the sustainable management of the site’s ecological, heritage and natural assets.\(^1\)

### 4.1.3 School Grounds

![Diagram of School Grounds](https://www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf)

There is a clear plan for the school, which will be legible for all users of the building (spatial organization).

There are varieties of external spaces and the entrance is clear linking immediately to the circulation of the school. There are views and daylight to core

---

circulation spaces with secondary staircases providing circulation within ‘houses’ (movement routes).

This drawing details the organization of the ‘school within a school’ model and allocation of both internal and external spaces for delivering the curriculum.

4.1.4 Organization

These diagrams explain how the buildings have been organized to respond to pastoral learning, community zoning, circulation, and ICT delivery. Elevations (Figures 4.22-4.27) show how the massing and material treatments respond to internal functions and different orientations.

Figure 4.18 principles. “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Figure 4.19 Personalized learning. “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Figure 4.20 circulation. “Available: www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf (Accessed 2007)”.

This drawing details the organization of the ‘school within a school’ model and allocation of both internal and external spaces for delivering the curriculum.
4.1.5 Buildings

The buildings have been organized to respond to pastoral learning, community zoning, circulation, and ICT delivery. Elevations show how the massing and material treatments respond to internal functions and different orientations.
4.1.6 Interior

Figure 4. 28 Learning street. “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Figure 4. 29 School Hall “Available: www.arnots.co.uk (Accessed 2010)”

4.1.7 Resources

At site level, the building’s orientation, ecological response and access to green transport inform the sustainability strategy.

At building level, it is met through ventilation and heating strategies (illustrated for both summer and winter), which are demonstrated in more detail in the fenestration design. Day lighting acoustics and ICT strategies are also addressed.

Mixed Mode Strategy
Ventilation and Heating Strategy

Figure 4. 30 Energy efficiency “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”
- High U values
- Efficient ICT
- Controlled lighting (occupancy sensor, daylight dimming)
- Controlled water flow
- Heat recovery

Figure 4. 31 Daylight example “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”
- Daylight factors above 2%
- Glare issues minimized with blinds
- Room depth meets day lighting room depth criterion
- Energy saved through sensor control lighting
Figure 4.32 Ventilation and heating to classrooms
- High efficiency heat recovery
- Local control through thermostats, CO₂ and occupancy sensors
- Guaranteed ventilation rates all year
- No draughts
- Night purge to provide cooling in summer

Figure 4.33 Night-time purging benefits

Figure 4.34 Thin client IT strategy

Figure 4.35 Photovoltaic energy system

Figure 4.36 Heat recovery units

Figure 4.37 Biomass renewable energy
Natural Ventilation

Figure 4.38 Summer day natural ventilation to curriculum spaces
- User control of windows during summer months
- Coolth from exposed concrete slab
  “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Figure 4.39 Extensive natural ventilation to atrium, end walls and roof vents
- End walls and roof louvers on BMS automatic actuators
  “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Atrium Cooling

Figure 4.40 Natural ventilation to atrium
  “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”
- End wall and roof edge louvers on BMS automatic actuators
- 20% shading to roof glazing to reduce solar gains

Figure 4.41 Mixed mode ventilation to atrium
  “www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”
- MVHR systems aids the natural ventilation at heat peak summer periods
- Free cooling is gained from classroom MVHR units
- Atrium is purged at night using BMS controlled louvers at high level
Figure 4.42 Renewable energy and sustainability targets

“www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Targets
- 60% carbon emission reduction from 2002 building regulation to meet DCSF requirements
- BREEAM very good as minimum
- 20% renewable

Figure 4.43 Building orientation

“www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

Strategy
- Mix of technologies to minimize risk, maximize benefits
- Mixed mode strategy to maximize natural ventilation when feasible and reduce heat loss and costs during winter months through MVHR units
- Utilize photovoltaic, water controls, biomass, thin client IT and intelligent ventilation

Orientation
- Making the most out of the site constraints
- Communal break out space is south facing
- Double height volumes located at south end of the building to shield the classrooms and work as buffer
4.1.8 Feeling Safe

Figure 4. 44 visual links between external spaces.
“www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”

A range of practical places for learning, socializing and exercising is shown. The fencing strategy has been well integrated with the building and landscape to define the use of the external spaces by students in the mainstream school, autistic spectrum disorder unit and local community. The strategy balances school security with the regard for the natural landscape, topography and openness of the site.
4.1.9 Long Life/ Loose Fit

![Diagram of current arrangement: Ground floor studios only](www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf)

![Diagram of potential for additional large studios](www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf)

Figure 4. 47 Classrooms flexibility/adaptability.
“ www.stanleyparkhigh.co.uk/assets/downloads/CABE_review.pdf”
The definition of ‘flexibility’ can vary from school to school. In the brief for this school, it is understood in terms of time. Structural solutions for different options over time are shown. Expansion is not a possibility given planning constraints, and this is clearly noted.

4.1.10 Successful Whole

External and internal visualizations show the whole school experience – from entrance to informal play - and the quality of materials used. The interior visualization indicates the function and atmosphere as well as the details of ventilation, light and acoustics within the main ‘street’.

At site level, the building’s orientation, ecological response and access to green transport inform the sustainability strategy.

At building level, it is met through ventilation and heating strategies (illustrated for both summer and winter), which are demonstrated in more detail in the fenestration design.
Day lighting, acoustics, and ICT strategies are also addressed. A range of practical places for learning, socializing, and exercising is shown. The fencing strategy has been well integrated with the building and landscape to define the use of the external spaces by students in the mainstream school, autistic spectrum disorder unit and local community. The strategy balances school security with the regard for the natural landscape, topography and openness of the site.

4.2 Fossil Ridge High School (LEED Certificate)

4.2.1 Identity and Context

“Fossil Ridge High School located in Fort Collins, Colorado. Fossil Ridge High School (FRHS) is the third high school in the United States to attain LEED Silver certification.”

“The school opened in August 2004 intended to help better distribute students in Fort Collins and alleviate pressure on Rocky Mountain High School.”

“Fossil Ridge High School is one of the thirteen nation-wide LEED (Leadership in Energy and Environmental Design) buildings. The school was constructed out of "green" materials and utilizes double-pane windows, as well as solar panels to produce energy. The school saves approximately $100,000 a year in utilities. Due to Fossil Ridge's environmentally friendly design, The Discovery Channel hosted a special highlighting energy saving and its importance in our modern society at the school.”

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“Fort Worth is the seventeenth-largest city in the United States of America and the fifth-largest city within the state of Texas. Located in North Texas and the western edge of the American South, The city is the second-largest cultural and economic center of the Dallas–Fort Worth–Arlington region.

The city was established in 1849 as an Army outpost on a bluff overlooking the Trinity River. Today Fort Worth still embraces its Western heritage and traditional architecture and design.

Fort Worth has a humid subtropical climate according to the Köppen climate classification system.

Because of its position in North Texas, Fort Worth is very susceptible to supercell thunderstorms, which produce large hail and can produce tornadoes.

Building on its western heritage and a history of strong local arts patronage, Fort Worth has, in recent years, begun promoting itself as the "City of Cowboys and Culture." Fort Worth Zoo has been named as a top zoo in the nation by Family Life magazine.”

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### 4.2.2 Site Plan

![Site Plan Diagram](image)

**Figure 4.51 Site plan with city parkland to the south.** "Sustainable School Book".¹

**Sustainable site:**

- “1930’s farm bldg now equipment storage PSD & City of Ft. Collins share ballfields
- Soccer field is recycled turf material White, reflect-ve roof lessens heat island
- Xeriscaping and bio-swales throughout site”²

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4.2.3 School Grounds

Figure 4.52 Floor plan showing academic zones, media & commons, athletics, performing arts and main entrance. Academic zone has 3 schools: 1. Business school. 2. Science school. 3. World language school. At upper level. "Sustainable School Book".

“The school is composed of three learning communities of 600 students each, with internal administration and student services.”

4.2.4 Organization

Design Goals

“Poudre School District in Fort Collins, Colorado is strongly committed to sustainable design, particularly minimizing energy use in their school buildings. In addition to the requirements and guidelines of the districts Sustainable Design Criteria, energy related goals for Fossil Ridge included:

1. Create a healthy and comfortable environment that would encourage learning.
2. Use the facility as a teaching tool for environmental design and stewardship.

3. Make a resource- and energy-efficient building that would reduce operating costs, leaving more district money available for classroom spending.

4. Make the design flexible and adaptable to accommodate any future programmatic changes.”¹

“LEED certification was not an initial design goal. However, the district decided to seek LEED certification at the end of the design process.”²

### 4.2.5 Building and Materials

<table>
<thead>
<tr>
<th>Figure 4. 53 Main Entrance. “Sustainable School Book”.³</th>
</tr>
</thead>
<tbody>
<tr>
<td>Figure 4. 54 Fossil Ridge High School providing a comfortable learning environment for students.&quot;Sustainable School Book&quot;.⁴</td>
</tr>
<tr>
<td>Figure 4. 55 These articulated windows and exterior window coverings allow maximum daylight into the building while minimizing the amount of direct sunlight. &quot;Sustainable School Book&quot;.⁵</td>
</tr>
</tbody>
</table>


² Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd. pg 120

³ Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd. pg 121.

⁴ Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd. pg 121.

⁵ Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd. pg 121.
Windows
High-performance, low-E glazed windows provide insulation to reduce heating demand and reduce solar heat gains to lower cooling demand. All classroom windows open for natural ventilation. Automatic sensors turn off heating and cooling when windows are open.

Building envelope
R-values for the exterior walls and roof exceed the ASHRAE\(^1\) 90.1-1999 standard by 37% and 43%, respectively.”\(^2\)

4.2.6 Interiors & Exterior Materials
The white roof reflects solar radiation, reducing the heat island effect and internal cooling loads.

![Figure 4.56 Most of the lighting for classrooms is natural, and operable windows allow fresh air inside without disrupting the heating, ventilating, and air conditioning (HVAC).](image1)

"Sustainable School Book".\(^3\)

![Figure 4.57 the interior spaces such as the Media Center are spacious and attractive.](image2)

"Sustainable School Book".\(^4\)

“...The light fixtures throughout the school are high-efficiency and are controlled by light and occupancy sensors. The fixtures in the classrooms also have dimmable...

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1. American Society of Heating, Refrigerating and Air Conditioning Engineers
ballasts that allow the occupants to further reduce artificial lighting when it is not needed.

Classrooms have operable windows, which allow natural ventilation. The windows are connected to the HVAC controls so that heating and cooling are turned off when the windows are open. The building envelope is tight and well insulated, and the HVAC equipment is high efficiency. An ice-storage system shifts cooling loads to off-peak hours in the evening and nighttime when electricity is cheaper.

The Poudre School District did everything it could to reduce environmental impact of this construction project. For example, 17% of all materials used in the school contain a high-recycled content, and more than half of (50%) all building materials are manufactured locally. The district took advantage of innovative ideas such capturing storm water in “bioswales”¹ and holding it in an adjacent pond for irrigating school grounds. In addition, the district preserved an historic 1930s farm building on the site, which will now be used for storing maintenance equipment.

The construction team recycled more than 70% of the building debris. This included grinding up the wasted pieces of gypsum board for use in landscaping.

To improve indoor air quality for students and faculty, the team used paints, finishes, and carpets that emit with low amounts of volatile organic compounds (VOCs). VOCs are known to degrade indoor air quality. Finally, the team also flushed the building with fresh air for two weeks after construction was complete and before it was occupied in order to rid the building of pollutants from construction.²

¹ Bioswales are landscape elements designed to remove silt and pollution from surface runoff water. They consist of a swaled drainage course with gently sloped sides (less than six percent) and filled with vegetation, compost and/or riprap
4.2.7 Resources

1. **Solar power**
   Large shaded windows at the entrance support 5.2 kilowatts of photovoltaic panels that supply emergency power to the building.¹

![Figure 4. 58 Shaded high classroom windows with view windows below gives light and energy. "Sustainable School Book".¹](image1)

![Figure 4. 59 PV panel sun shades demonstrate "Sustainable School Book".²](image2)

2. **Electricity:** 100% of electricity needs are supplied by wind power purchased from the local utility. Energy Use (energy model) Approximately 30 kBtu³ per square foot is used annually for gas and electricity.⁴

![Figure 4. 60 Eight large insulated tanks store ice made during off-peak hours when electrical rates are lower. "Available: www.cres-energy.org (Accessed 2008)"](image3)

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³ KBTU Kilo British Thermal Units


3. Day lighting

Windows provide 100% day lighting in most classrooms year round, using clerestories on the north and south sides. High-performance Sensors and dimming ballasts adjust artificial lighting based on available sunlight.¹

![Figure 4.61 Students enjoy open, daylight spaces.](image1) "Sustainable School Book".²

![Figure 4.62 Fossil Ridge High School library.](image2) "Sustainable School Book".³

4. Air conditioning

**Using energy recovery systems:** Approximately 40% of the total airflow required to condition a classroom is outside air. Once this air is brought into the space, it has to be exhausted from the building. The exhausted air is passed through an energy recovery wheel to preheat or pre cool the incoming outside air, reducing the energy needed to heat or cool the air.

Chillers produce thermal storage ice at night for cooling during the day. Shifting the cooling load to off-peak demand creates savings of $9.00 per kilowatt, and allowed installation of a smaller chiller.

The cooling system incorporates a standard 135-ton chiller coupled with a partial ice storage system. The system makes ice during off-peak hours when electrical rates are lower. The ice is stored in eight large insulated tanks. During the day when cooling loads increase, the cooling system uses the stored ice to provide additional cooling.⁴

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5. Heating
High-efficiency condensing boilers (up to 97%) are used to generate 140°F heating water. The water is circulated to all of the air handlers and terminal heating units by base-mounted pumps with high-efficiency motors. A fully interactive direct digital controls (DDC) system operates all the equipment to maintain a quiet, comfortable learning environment.¹

![Diagram of December Day Demand Profile](image)

6. Water conservation is a key concern across Colorado. Fossil Ridge uses a raw water pond for campus irrigation, low-flow faucets and toilets, and artificial turf for the athletic field.²

7. Indoor air quality: A primary concern for Poudre, the building features operable windows to let in fresh air, carbon dioxide sensors, and paints and furnishings with low volatile organic compounds (VOCs).³

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Fossil Ridge High School is attractive both inside and out, and includes a number of design features intended to minimize energy bills and at the same time maximize comfort conducive to a learning environment. The plan layout is oriented east to west for good solar exposure and maximum control of direct sunlight. Control is important because allowing direct sunlight into occupied spaces can cause glare that distracts students who are trying to study and can overheat south and west-facing rooms in the summer.

At the front entrance, a solar photovoltaic (PV) power system rated at 5.2 kilowatts (kW) greets arrivals at the front entrance and gives the entire school a modern, “high-tech” look. The PV array produces power at the same time it shades the front windows, which controls the direct solar gain to reduce overheating.  

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4.2.8 Feeling Safe

Figure 4.65 The school is one Building has all the spaces that is help for the security. And the courtyard in the school make the students feeling safe from visual links. "Sustainable School Book".  

4.2.9 Long Life, loose Fit

Flexibility in the program is demonstrated by features such as retractable seating in the auditorium, which creates additional fine arts instruction space; an indoor running track, which is incorporated through the main and auxiliary gymnasiums; and sharing of the culinary arts and career and technical education programs with the local community college.  

4.2.10 Successful Whole

Students enjoy and benefit from the new school’s environment, and families can be confident that the school district went to great lengths to provide the best learning environment.

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2 “Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd, pg 120"
4.3 Science Park High School

4.3.1 Identity and Context

"Science Park High School, formerly known as Science High School, is a magnet public high school located in Newark, in Essex County, New Jersey. The school opened in 1974.

The mission of Science Park High School is to transform mathematics and science teaching and learning by developing ethical leaders who know the joy of discovery and forging connections within and among mathematics, science, the humanities and the arts by means of exemplary laboratory environments characterized by research, innovative teaching, and service."\(^2\)

"Essex County is the second most densely populated county in the state after Hudson County, and has the third largest total population after Bergen County and Middlesex County.

Like many of the counties of Northern New Jersey near New York City — which tend to have sharp divides between relatively rich suburban neighborhoods and less wealthy, more densely-populated cities nearby — the eastern region of Essex County tends to be poorer and more urbanized, while the western parts tend to be more affluent and suburban.

\(^1\) Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd, pg 171.

Eastern Essex This wide area has significant pockets of areas that qualify as inner city: high building density, high poverty and high crime rates and underperforming school systems. Beginning at about the turn of the century, this region led the state in the rebuilding and rehab of its housing stock. Crime in this part of the county has traditionally been among the highest in the state and the country as well, but recently has also seen significant declines, in contrast, Western Essex tends to be suburban and affluent. Within this region are some of the most diverse and racially integrated municipalities in the state and nation.¹

"For 32 years, Science High School was at 40 Rector Street in Newark. The building was originally the Ballantine Brewery. After the brewery closed, it was
acquired by Rutgers-Newark and was converted into a facility for chemistry research and training. In the 1970s, the Newark Public Schools leased the structure and converted it for use as a high school.

Science High School officially left the Rector Street building in November 2006 to move to its new location adjacent to Newark's Science Park. Accordingly, the class of 2010–2011 will be the first class to graduate Science Park High School having spent full four school years in the new building located at 260 Norfolk Street.

The new building has a capacity of 800 students and is located on a 6-acre (24,000 m²) campus. The school was renamed Science Park High School because of its location near and connections with the University Heights Science Park.

University Heights Science Park is a collaborative venture between Newark's higher education institutions, the City of Newark, and private industry designed to harness university science and technology research as a force for urban and regional economic and community development.

University Heights Science Park is uniquely positioned to provide technology businesses with a competitive advantage through its ties with the three NJ public research universities located nearby: New Jersey Institute of Technology (NJIT), The University of Medicine & Dentistry of New Jersey (UMDNJ) and Rutgers University at Newark. The building includes a state of the art solar and geothermal energy system and highly efficient heating and cooling. ¹

### 4.2.3 School Grounds

"The heart of the high school will be an “Academic Village.” The project team created an environment that facilitates a student-centered and interdisciplinary teaching team approach, in a building that must also function as a community

resource. Four distinct “neighborhoods” (Educational Learning Modules or ELM’s) will each house a maximum capacity of 300 students. Each will comprise Home Base Classrooms, Science Labs, Teacher Planning, Lecture rooms and support spaces. These four ELM’s will be paired and located on the second and third floors around a central atrium space.

Ground floor support spaces are organized around the “Village Commons” at the base of the atrium. The Instructional Media Center (IMC) the focal point of the school and the primary link to the community sits adjacent. It is directly accessible from the main entrance and clearly visible from the building exterior. Other functions include Administration, Student Support Services, and the Cafeteria.

Throughout the high school, Science Labs, Lecture, Seminar and Research rooms are all designed to maximize student-based inquiry. Fabrication areas with workstations provide for hands-on exploration of robotics, electronics and other technology based innovative processes. Multi-Media Labs, CAD and ITV areas will function as both communication production centers and as instructional areas for student and staff development. An Outdoor Habitat, designed with the assistance of the State Conservancy, will augment both Horticulture Lab-House and Art Studio areas.

To further support these activities, the Auditorium was designed to allow for large-event science demonstrations. Staff planning, development and mentoring areas will allow students’ easy access to school staff and visiting mentors.\footnote{Available: http://www.designshare.com/index.php/projects/newark-science-park-high/narratives (Accessed: March 2010)}
1. Information media center  
2. Atrium/village commons  
3. Student services  
4. Administration  
5. Cafeteria  
6. Auditorium  
7. Swimming pool  
8. Music  
9. Gymnasium  
10. Education learning module  
11. Art  
12. Green house  
13. Classroom  
14. Science lab  
15. Preparation  
16. Elective  
17. Lecture  
18. Teacher planning  
19. Student research
4.2.4 Organization

![Figure 4. 76 Building organization. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”](image)

![Figure 4. 77 Zoning and circulation. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”](image)

4.2.5 Buildings

"The building’s exterior is intended to clearly communicate the use of the building as a science and technology high school, and as a community resource. Sustainable design features such as photovoltaic panels have been incorporated into the building aesthetic. Major building elements such as the ELM’s, IMC, Auditorium and athletic program spaces are prominently articulated as distinct masses. The educational program is expressed through the building form, captured in a rich staccato of contemporary architectural materials seamlessly mixed with structural and MEP systems components. A stimulating vocabulary begins to hint at the amazing opportunities for exploring science within."¹

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Figure 4.78 Conceptually, the building maximizes the use of tight site-the articulation of the building massing, the use of brick, metal panels, and glass, and the expression of photovoltaic panels celebrate science and the learning opportunities within. “Sustainable School Book”.

Figure 4.79 Masses

Figure 4.80 Elevation

Figure 4.81 West elevation. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”

Figure 4.82 North elevation. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”

Figure 4.83 South elevation. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”

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1 Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd, pg 171.
Figure 4.84 East elevation. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”

Figure 4.85 Building section. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”

Figure 4.86 Building section. “http://www.designshare.com/index.php/projects/newark-science-park-high/images”
4.3.6 Interiors

"Classrooms: Classrooms will provide each student an instructional home base at a research carrel. Students will work on multi-discipline inquiry projects under the supervision of a mentor or teacher. A 1:1 computer to student ratio with ample peripherals will permit effective use of digital and wireless technologies.

Science labs: Science labs will function as classrooms/labs with the flexibility to accommodate changes in curriculum goals and technological advancements. Computers will permit use of microscopes, probes, sensors and other data collection devices that augment the computer’s role in scientific inquiry. Some labs have been equipped with FDA style food science workstations that allow student inquiry in this growing field of science."\(^1\)

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"ITV Room: An ITV Room will allow students to participate in telementoring and video-conferencing for project research or to broadcast their own research to other facilities.

These areas will also allow students to participate in courses at centers of higher learning and give access to staff development programs.

Student research rooms: Students will have access to many large research databases through their multi-platform network and the equipment to analyze their own data collections such as tracking changes in the Earth’s magnetic field or analyzing air quality.

Research rooms may include:

- Computer controlled microscopes, digital imaging peripherals, virtual imaging screens, vernier sensors and probes that can work with computers or PDA’s for data collection/analysis and virtual microscopy equipment."1

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"Critical to building these skills of learning is the link between teaching science and using the school itself and the grounds as a hands-on laboratory to learn about sustainable design. Geothermal boreholes will be located over the playing fields and parking lots. Individual control zones are to be provided throughout the school. Energy recovery units will recapture exhaust air temperature to provide high-energy savings and comfort. Variable frequency drives and high efficiency motors will be located throughout the various systems. Besides being able to observe first-hand how these systems operate, building controls for all of these will be accessible to students for analysis through “read only” computer stations.

**Sustainable features:**

- The structure is expressed within the building, which serves as an educational tool in addition to material supplies and costs saved during construction
- Photovoltaic panels are used to power student experiments within the building
- 16-foot (5-meter) floor-to-floor heights allow day lighting controls using sunscreens, light shelves, indirect lighting with light sensor controls, and introducing natural day lighting at many opportunities such as the atrium, stairwells, and gymnasium"¹

¹ Alan Ford,(2007) Designing the Sustainable School. Australia:The Images Publishing Group Pty Ltd, page 170
• "The geothermal heat pump system cuts energy consumption by approximately 30%; room-by-room, zone-by-zone heating and cooling increase user comfort and allow heating energy to be moved from warm zones to cool zones
• The project includes a geothermal well field consisting of 375 holes
• The main atrium ("village commons") utilizes acoustical control, increased ventilation, and CO2 monitoring
• The school incorporates healthy and high-performance features, designed for LEED silver certification, made possible by the aggressive pursuit of rebates totaling more than $1 million”

1 Alan Ford,(2007) Designing the Sustainable School. Australia: The Images Publishing Group Pty Ltd, page 170
4.3.8 Feeling Safe

A range of practical places for learning, socializing and exercising is shown.

4.3.9 Long Life, loose Fit

Using the renewable resources make the school long life.

4.3.10 Successful Whole

"This new science magnet high school will be a dynamic model of how technology can be utilized in educational delivery. It is one of the first beneficiaries of a capital program spearheaded by a state construction program to build innovative new schools. In collaboration with a public/private partnership, that includes the school district, regional universities and high technology industries; this facility was planned utilizing Instructional Technology Standards that define infrastructure, equipment to student ratios, maintenance standards, and alignment of technology resources to curriculum goals. These groundbreaking educational ideas are the way in which the new school will help foster social progress and the renaissance of this economically depressed area."¹