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Cesar Chavez Elementary

The Cesar Chavez Elementary School is exemplary of a growing trend in the United States; the greening of Public Schools. Despite notable challenges in terms of budgeting, liability, and time constraints, schools across America are seeking out innovative designs and systems in name of the environment and student health. (Schneider, 2002; USGBC; CHPS; Kennedy, 2008)

The trend is particularly strong in California, and despite what many may assume it's not limited to those schools within the income-tax zones of the affluent and white. Cesar Chavez is located in Long Beach, California, where the median household is just shy of a modest 46k per year. Nearly 40% of the district is Hispanic, and many are foreign born (US Census Bureau). The neighborhood North of Chavez suffered overcrowded schools and inadequate municipal infrastructure; this latter neighborhood was busing over 2000 students daily outside the school district before the Cesar Chavez elementary school was completed in 2004. (BuildingGreen)

Cesar Chavez is particularly significant to the Long Beach community because it is the first Long Beach school to be CHPS certified (BuildingGreen; Cesar Chavez). CHPS, or the Collaborative for High Performance Schools, was birthed in 1999. After a decade of brown-outs and other energy issues, "the California Energy commission called together Pacific Gas and Electric Company, San Diego Gas and Electric, and Southern California Edison to discuss the best way to improve the energy performance of California's schools" (CHPS).

While this non-profit group was originally created to address energy issues, CHPS quickly expanded to address other environmental and also educational issues as well. CHPS saw an opportunity to bring a new standard to the role schools play in terms of student health, the environment, and community (CHPS). To CHPS, a High Performance school is not just one "that has strived to achieve excellence in environmental efficiency and healthy building practices" (CHPS).

It is also a building which teaches by its own design and provides a comfortable, adaptable environment that improves teacher moral and facilitates student learning.

CHPS schools should serve as a source of pride and identity for the surrounding communities (CHPS).

To accomplish this, CHPS had to overcome a series of challenges revolving primarily around information access. The CHPS began a series of seminars and conferences to help educate administrators as to the benefits and costs of High Performance Schools. Green schools had a significant challenge to overcome due to misconceptions that greening negates serious expenses. According to CHPS, however, a green school can be built on a budget as low as $1.50 per square foot. CHPS also set up a series of databases accessible on their website which linked districts to green designers and provided comprehensive lists of green strategies and low-emittance materials. Their Best Practices Manual which covers most of these aspects was made available in 2001 and can be downloaded for free (CHPS).

In 2001, CHPS met with representatives of the LEED system created by the USGBC to look into adapting LEED to schools (CHPS). At the time, the USGBC had no building specific policies and no intention of creating them (CHPS). The CHPS felt that, since "minimum compliance with California codes and regulations achieved LEED points" (CHPS) and "the LEED rating system did not address many issues critical to high performance schools such as acoustics, daylighting, electric lighting, low-emitting materials, [or] joint use of facilities" (CHPS), LEED certified schools didn't necessarily translate to High Performance Schools (CHPS).

LEED also required third party verification[1] (which also meant slower construction), and additional funding to certify the school (CHPS). CHPS felt this would make it difficult for low-income schools to achieve green status, and also worried that LEED's use of national, instead of state, building codes might make it easier for some schools to achieve LEED status than others (CHPS).

As a result, CHPS created its own system. The current CHPS system has a possible 85 points, and a school needs at least 32 to be CHPS certified. Schools can self-verify, and the majority of CHPS resources are free. Also according to CHPS:

> A project that scores the minimum number of CHPS points is not equivalent to a minimum scoring LEED project. A brief analysis of the CHPS and LEED point systems reveals that the CHPS' Criteria are more stringent than LEED at the minimum

[1] CHPS allows schools to self-certify, which can help schools to reduce costs.

certification levels. When a CHPS school meets all of CHPS' prerequisites, it has met all of LEED's prerequisites. However, by merely meeting four out of the eleven CHPS prerequisites (EQ2.0, EQ4.0, ME2.0 and EE1.0), a project will have earned at least 7 additional points under LEED for Schools. Thus, a school that earns the minimum point requirements for CHPS (32 points) would most likely earn a LEED for Schools Silver certification (approximately 37 to 40 points). Conversely, a project that qualified for LEED's minimum certifications (a LEED for Schools Certified School) would most likely not earn CHPS certification. (CHPS, 2007)

Cesar Chavez was completed in 2004, and used a slightly different CHPS point system than the one described above. Chavez earned 32 out of a possible 81 points, with 28 points being needed to qualify for CHPS certification (CHPS; BuildingGreen; Cesar Chavez).

The CHPS system ultimately has the same goals as the LEED system and works similarly. There are specific categories, each of which has a particular number of points. Each of the sections in the CHPS system is listed below, with an analysis of what was done at Cesar Chavez to meet CHPS certification.

Figure 1: Cesar Chavez from the front entrance.

SITE:

14 Possible Points, 2 needed for CHPS certification

The first aspect of environmental and community responsibility was addressed by Chavez with its location; the Long Beach Unified School District, LBUSD, chose a greyfield site holding mostly abandoned warehouses and a few low-income apartment buildings[2]. The site was largely regarded as an eyesore, and was lacking adequate infrastructure. Water systems in particular were especially outdated, and the building of Chavez saw that significant improvement came to the sewer and pipelines. In addition, the design of the school increased open space and also led to improved pedestrian

[2] Those dwelling within the apartments were financially assisted with relocated by the Long Beach Redevelopment Agency (BuildingGreen)

pathways, which helped the community to take advantage of the five acre park near the site. (BuildingGreen)

The school also takes advantage of the park, using it for open space during recess hours. Normally, schools and cities do not share such spaces but CHPS felt that community and school relations could be improved by the encouragement of shared spaces (CHPS). Chavez therefore entered into a unique agreement[3] with the City of Long Beach where in exchange for school use of the park during school hours, the school allows the community to utilize the gymnasium after school hours (BuildingGreen).

Another feature of Chavez is that it only takes up 2.6 acres of building space, with 5 acres of field space (CHPS; BuildingGreen). This is considerably smaller than the 11 acres of space recommended by the California Department of Education (CHPS). Chavez was able to reduce total land space used by the school by sticking to a two story design, instead of a sprawling one story school (CHPS; BuildingGreen).

Additionally, the school is located near a mass-transit hub and near the majority of students' homes—most students actually walk to the school. "LBUSD estimates that nearly 95% of the building occupants use transit options other than single occupancy vehicles….the school reduced the need for onsite parking by 63%" (BuildingGreen, 2007). Also, the site had a significant amount of street parking, which further reduced the size of Chavez' parking lot.

Figure 2: Photo of Cesar Chavez demonstrating light colored cement used to reduce albedo.

Chavez also took into consideration the school's effect on the urban climate. Chavez utilizes a cool roof, and planted several dozen new trees to reduce heat. The landscaping of the school makes use of native, drought tolerant plants to reduce irrigation needs and mulch to reduce evaporation. Irrigation is also reduced via the water system; sensors in the ground calculate evapotranspiration rates and water accordingly. The sprinkler heads and controllers are also equipped with a water budgeting feature. "The

[3] Chavez also has an agreement with Children's Memorial Hospital of Long Beach, and houses a children's health clinic. This is a valuable service the community previously had lacked. CHPS does not offer points for this.

project's total estimated irrigation water use is 100,000 gallons per year less than the base allowance" (BuildingGreen, 2007).

Chavez also chose to address water run-off. All run-off is collected into on site storage bins and then passes through a Continuous Deflective Separation unit. The CDS filters all the run-off before allowing it to run into the sewer system. (BuildingGreen)

The architecture of Cesar Chavez is also incredibly unique. This is mostly because of necessary innovations to make an environmentally friendly school, but it also makes Chavez a "focal point of the community, thereby strengthening the neighborhood's self-concept" (BuildingGreen, 2007).

ENERGY:

24 possible points, 2 points needed for CHPS Certification

Chavez had decided to go green before they were initially aware of CHPS certification, and was already committed to conserving energy with the installation of a HVAC system. Fortunately, the LBUSD met up with Savings By Design, an innovative architectural group brought together by the same companies that created CHPS (CHPS). Savings By Design introduced Chavez to several additional methods by which the school could reduce energy loads (BuildingGreen; Cesar Chavez).

One particular method is passive solar design, which essentially means that the building is built with the natural climate of the region taken into consideration. In the case of Chavez, an east-west orientation meant that the building received more uniform sunlight and was able to benefit from the coastal breezes (CHPS; BuildingGreen).

Chavez also used energy star compliant windows, and equips them with overhead shades so that the amount of direct sunlight coming in through the window is reduced.

Figure 3: Top Story Cesar Chavez window with horizontal solar shade.

This reduces heat build up and also protects students from glare (BuildingGreen).

Chavez also helps to reduce energy in other ways. The "typical Cesar Chavez classroom includes three rows of six four foot pendant direct/indirect light fixtures" (BuildingGreen). These lighting fixtures use fluorescent bulbs which can be dimmed—during the day, they operate at only a fifth of their full capacity. This saves energy not only be cutting down on total electricity needed, but also reduces heat generation, thus saving cooling costs (CHPS). Classrooms also have independent thermostats, so teachers can adjust thermal settings themselves (BuildingGreen). The school also saves on cooling costs by using a passive evaporative cooling system for the gym (BuildingGreen).

The lighting system also has occupancy sensors, so the lights will turn on whenever someone is present in the room (BuildingGreen). Other schools have worked to save energy by keeping all lights on timers, but this has created problems for teachers (Schneider, 2002).

Figure 4: Typical Chavez Classroom. Visible Celestory windows and the lighting system.

Overall, Chavez saves approximately 29,000 every year in operating costs thanks to the various methods by which they have chosen to reduce peak electric loads (BuildingGreen). Their commitment to this not only helped the school to earn CHPS rating, but also helped to fund the construction—Savings By Design offers several financial incentives if a school can reduce energy by at least 10% more than is already called for in CA's Title 24 energy-efficiency building code. Chavez was able to reduce energy by over 30%, and earned 30,000 dollars to help fund the school (CHPS; BuildingGreen).

Indoor Environmental Quality

17 possible points, 3 points needed for CHPS Certification

It is an interesting aspect of school design history that during the energy crisis of the 70s, schools were designed with the idea that 1) windows negatively affect insulation and thereby increase heating/energy needs and 2) windows increase student daydreaming and thus negatively impact student learning. As a result, this era saw the formation of a number of windowless prisons now recognized as representing many of the worst learning centers in the country in terms of energy efficiency, indoor environmental quality, and student performance (Schneider, 2002).

Research independent of CHPS has demonstrated that student performance is greatly affected presence of daylight, background noise, and Indoor Air Quality or IAQ (Schneider, 2002; Eley, 2006; Kennedy, 2008). CHPS felt it was important to make sure that these factors were taken into consideration during the construction and design of a high performance school (CHPS; Kennedy, 2008).

A 1999 study conducted by the Heschong Mahone Group demonstrates clearly that natural daylight results in more productive, focused students (Schneider, 2002; Eley 2006). Additional research also suggests that a lack of natural daylight can interfere with hormone production, which can negatively impact child health. (Schneider, 2002) Chavez hallways have skylights to allow daylight in from above (as well as top level classrooms), and there are clerestory windows between hallways and classrooms. All classrooms and offices also have windows facing the outdoors as well. Those with a southern exposure are equipped with awnings and windows are also laminated with a low-emittance glaze to prevent and reduce glare (BuildingGreen).

Acoustics are also problematic. Students who cannot hear their teachers are obviously not inclined to pay attention (Schneider, 2002). Teachers are also aggravated by consistently having to raise their voices to talk over air conditioning or howling heat vents. Chavez uses special ceiling tiles and wall panels to help sound proof classrooms (BuildingGreen).

The third issue and also greatest health threat stems from Indoor Air Quality, or IAQ. Scientific Studies have emerged suggesting that poor IAQ is extremely harmful to student focus and health (Schneider, 2002; Eley, 2007; Kennedy, 2008). Even the build up of relatively benign gases, such as Carbon Dioxide, can negatively impact student health and learning:

> When carbon dioxide levels reach 1000 parts per million (about three times what is normally found in the atmosphere), headaches, drowsiness, and the inability to concentrate ensue. Myhrvold et al. (1996) found that increased carbon dioxide levels in classrooms owing to poor ventilation decreased student performance on concentration

> tests and increased students' complaints of health problems as compared to classes with lower carbon dioxide levels. (Shneider, 2002)

Enforcing good IAQ is especially important when it comes to facilities that house children because children breathe in a greater volume of air proportional to their body weight as compared to adults (Schneider, 2002). As a result, they are at increased exposure risk to airborne toxins. 1 in 5 children suffer poor IAQ at their school, and it has been scientifically demonstrated that poor IAQ leads to increased absenteeism (Schneider, 2002). Aside from the possibilities of headaches or nausea, poor IAQ also aggravates asthma and allergies (Schneider, 2002; Eley, 2007). The variety of poor IAQ symptoms falls under the umbrella of Sick Building Syndrome, a term "used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified"(EPA, 2008)

Sick Building Syndrome was coined by the EPA in the beginning of the century to describe the health affects posed by buildings were poor ventilation led to a build up of Carbon Dioxide, VOCs (Volatile Organic Compounds), mold, mildew, or bacteria. VOCs are released from certain building materials, and their release into the atmosphere can cause the formation of ground level ozone, a known aggravate of asthma (CHPS; USGBC; Schneider, 2002). Buildings with poor ventilation can also suffer high humidity, which can lead to the growth of biological irritants like mold too (Schneider, 2002).

Chavez addressed IAQ through two particular strategies. The first, amazingly simple one was to make sure all windows were fully operational. This may seem surprising but many schools have fixed windows that cannot be opened[4], which obviously prevents classrooms from bringing in fresh air. Fully Operational windows have another surprisingly benefit as well— it has been shown that being able to open classroom windows greatly improves teachers' moral. Teachers who can open their windows feel as though they have more control over the classroom, and tend to feel more positively about their schools. (Schneider, 2002)

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[4] This is another trend of 1970s schools. In this instance, the idea was that open windows were poorly sealed and therefore allowed too much heat/cool air to escape. (Schneider, 2002)

The second was a little more difficult, but was particularly essential to CHPS certification and good IAQ; Chavez had to carefully choose building materials that were sustainable and qualified as low-emittance substances, meaning that they would not release any VOCs. These choices contributed to Chavez's success with the energy requirements of CHPS, but also contributed to their success with materials.

Materials

11 points possible, 1 prerequisite

The majority of floors in Chavez are made of Marmoleum and artoleum, durable low-emittance linoleum products (BuildingGreen). The floors are made of linseed oil, woodflour, resin, and limestone (Forbo). They can last up to 40 years, and are fully biodegradable. Due to their low static charge and porosity, these flooring options are also naturally hygienic and require only dry mopping and spot cleaning to maintain (BuildingGreen). The reduction in cleaning chemicals helps to reduce VOCs, and the natural hygiene of the flooring cuts down on bacteria, mold, and mildew. They are also fire resistant (Forbo; BuildingGreen)

Figure 5: Inside look at Chavez. Visible are the marmoleum floors, and also light coming in from skylight and celestory windows looking into classroom.

The wall panels in Chavez are made by Tectum, and are made from certified sustainable wood. Tectum Interior products specialize in reducing acoustics but also strive for environmental sustainability (Tectum).

Chavez also used formaldehyde free batt-insulation made from recycled post-consumer content. Again, the material helps to satisfy CHPS criteria to use recycled goods while also improving IAQ. Other recycled content includes the playground floors, made of recycled rubber, and the mulch which is recycled wood (BuildingGreen).

Figure 6: Play area with recycled rubber flooring

Also as per CHPS materials requirement, Chavez has recycling containers throughout the school (BuildingGreen; Cesar Chavez).

Water

5 Points possible, 1 prerequisite

Chavez unfortunately did not address much in the specific water category, outside of meeting the prerequisite to set a water budget. Though they did use native plants and attempted to reduce irrigation, it would seem that perhaps they did not reduce enough to earn points under water. Total potable water use is over one million gallons per year (BuildingGreen).

Since California has significant issues with water availability, it is hard to understand why Chavez did not put more effort into addressing this issue. Perhaps the district is an exception to the state trend, or perhaps there were other challenges the school faced that made reduction of water difficult. Its presence in an urban area, though a site prerequisite for CHPS certification, may have made water use difficult to reduce due to infrastructure constraints. There may also have been upset among parents concerned that recycling water systems may negatively affect children's hygiene, even if these concerns are unwarranted.

District Resolutions

10 Possible points; no prerequisites

Though the LBUSD demonstrated significant dedication to the community, it earned no points in district resolutions under the CHPS system. Reasons for this are unclear, however it must be kept in mind that District resolutions extend well beyond Cesar Chavez Elementary. Most likely, the district had other schools where application of these resolutions would have been costly or otherwise difficult, and therefore was unable to meet the CHPS requirements.

Conclusion

Cesar Chavez, despite lacking commitment to water reduction and district resolutions, is ultimately a wonderful example of the benefits that come from green schools; "Several informal evaluations have reported that the staff, student, and community reaction to the facility is overwhelmingly positive" (BuildingGreen). There is a newfound sense of optimism throughout the community, along with an increased sense of identity (CHPS; BuildingGreen).

When Chavez was first designed, CHPS was only available to California schools. However, with the demonstrated success of schools such as Chavez, the system is expanding and has now been adopted in a series of other states. It may also have inspired LEED to change its policies on creating building-specific systems. In 2007, LEED for Schools made a debut and is growing increasingly popular particularly along the East Coast (USGBC; CHPS).

Whichever certification system a school chooses to go with, it is clear that green schools benefit more than just the environment. Aside from health benefits from improved IAQ and increased daylighting, there have also been observational studies demonstrating that students and teachers take a lot of pride in green schools (Schneider, 2002). As a result, green schools suffer less vandalism, and also have less disciplinary problems. Such studies are probably somewhat skewed because green schools are more likely to occur in high-income districts, but it seems very reasonable to conclude that a student would be happier in a school such as Chavez.

The Chavez school cost 15,548,000 dollars, and was completed in 2004 (BuildingGreen). It saves a little less than 30,000 in utilities each year (BuildingGreen; CHPS). However, there is no price available for the benefits it has brought; a children's clinic, a place for community recreation, and a healthy new school for a previously overcrowded district.

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