REPORT

ON Hawaii School Decision Maker Forum:

TECHNIQUES AND TOOLS TO ENHANCE LEARNING ENVIRONMENTS

A Report To The

State of Hawaii

Department of Business, Economic Development & Tourism

Energy, Resources, and Technology Division

November 2002

U.S. Dept. of Energy Rebuild America

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Hawaii School Decision Maker Forum

TECHNIQUES AND TOOLS TO ENHANCE LEARNING ENVIRONMENTS

October 30, 2002
Oahu Country Club

7:30 a.m.	Registration and Buffet Breakfast
8:00 a.m.	Executive Session Opening Remarks: Carilyn O. Shon (Moderator), Energy Conservation Program Manager, Energy, Resources, and Technology Division, DBEDT Patricia Hamamoto, Superintendent of Education Jackie Erickson, Vice-President Customer Relations, Hawaiian Electric Co., Inc. Speakers: Patricia Plympton, CEM, Sr. Project Leader, U. S. Department of Energy, National Renewable Energy Laboratory Charles Eley, FAIA, PE, President, Eley Associates Steve Meder, PhD, Associate Professor, University of Hawaii at Manoa, School of Architecture Closing Remarks: Maurice Kaya, PE, Program Administrator, Energy, Resources, and Technology Division, DBEDT
9:00 a.m.	Break
9:15 a.m.	Energy Design Guidelines for High Performance Schools—Patricia Plympton
9:45 a.m.	National Best Practices for High Performance Schools—Charles Eley
10:15 a.m.	Break
10:30 a.m.	Guidelines for Cooling Portable Classrooms in Hawaii--Status Report—Steve Meder
11:15 a.m.	Case Study on Results of Enhanced Environments—Charles Eley
11:45 a.m.	Energy Smart Schools Opportunities—Patricia Plympton, Sam Nichols
Noon	Lunch
1:00 p.m.	WORKING GROUP SESSION—Leaders: Charles Eley and Patricia Plympton Objective: Apply Best Practices Guidelines and Develop a Framework for Hawaii Schools 1. Feedback on Kapolei High School 2. Pre-engineered Solutions for Daylighting, Lighting, and Insulation; HVAC a. New Construction b. Temporary Classrooms 3. Retrofits, Repair and Maintenance 4. Effective Educational Specifications

Co-Sponsors
Department of Education, Hawaiian Electric Co., Inc., National Association of State Energy Officials, National Renewable Energy Laboratory, Department of Business, Economic Development & Tourism/ERTD, U.S. Department of Energy, Rebuild America and EnergySmart Schools Programs

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Oahu Country Club
30 October 2002

INTRODUCTORY STATEMENTS

Moderator: Carolyn Shon, Energy Resources, and Technology Division (ERTD), State of Hawaii Department of Business, Economic Development, and Tourism (DBEDT)

Special Thanks to co-sponsors: US Department of Energy / Rebuild America-Eileen Yoshinaka; Energy Smart Schools/National Renewable Energy Laboratory-Patricia Plympton; National Association of State Energy Officials-Kate Burke; Hawaiian Electric Company-Jim Maskrey; DBEDT-Rebuild Hawaii State-Liz Raman.

Pat Hamamoto, Superintendent of Education

Achieving High Performance Schools (HPS) in Hawaii, must include forming Partnerships between the State of Hawaii Departments of Education (HDOE), Accounting and General Services (DAGS) and Business, Economic Development and Tourism (DBEDT). This issue is timely and shows the commitment of HDOE to the school environment.

Jackie Erickson, Hawaiian Electric Company (HECO)

Energy efficiency should form the background to improved learning. Utility rebates are an important motivator as shown by HDOE saving 1.1 megawatts of power to realize rebates of $399,193 over six (6) years.

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Patricia Plympton, National Renewable Energy Laboratory (NREL)

Schools, nationwide, average between 40-50 years old, making it important to:

1. Model designs to test performance
2. Design in flexibility – especially in Hawaii where the "community facility" role dominates and schools are heavily used for non-academic purposes
3. Design for easy maintenance and longevity

Since renovation of existing stock dominates the planning horizon for HDOE, assistance is available to evaluate the best practices most appropriate to Hawaii schools:

1. Rebuild America design charettes
2. National Design Guidelines for High Performance Schools (HPS)
3. National Best Practices Manual

Charles Eley, Eley Associates

HPS are:

1. Healthy – designed to promote health
2. Comfortable (thermally, visually, acoustically)
3. Efficient (energy, water, materials)
4. Educational (alternative technology and environmental lessons)

Steve Meder, University of Hawaii, School of Architecture

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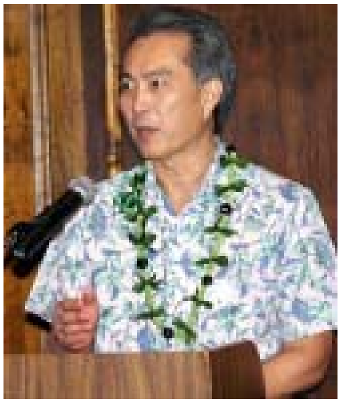

Maurice Kaya, DBEDT - ERTD
The partnership between DAGS, HDOE, HECO, UH and DBEDT has included federal partners such as the US Department of Energy (USDOE) and national partners such as the National Association of State Energy Officials (NASEO). It is not a new partnership and has resulted in valuable products including the Hawaii Model Energy Code and other Hawaii specific guidelines.

FORMAL PRESENTATIONS (Q = Question, A = Answer, C = Comment)

Patricia Plympton, NREL. "The EnergySmart Schools Program"
The EnergySmart Schools Program provides K-12 assistance to Rebuild America programs throughout the country. Their National Best Practices manual is available in hardcopy (attendees to receive a copy) and by calling 800-DOE-EREC or www.energysmartschools.gov. See attached presentation.

Q. Are checklists available?
C. Daylighting implies air conditioning (AC), but AC is a huge up front cost (10%-40% of the cost of the school).
C. Policy of DAGS is to look at specific schools for AC and not provide all schools with AC, but this process is defective. For instance, Mililani has AC (and shouldn't because it could capture trade winds) and Nanikuli does not (but should because of hot and humid conditions).
C. The need to AC schools in Hawaii is SITE SPECIFIC. There is also a need to balance the need for energy efficiency (EE) with quality of life. Lastly, quality of life improvements must be factored into the lifecycle costs to justify up front costs.

Charles Eley, Eley Associates. "The Collaborative for HPS"
Background on the CHPS program. See attached presentation.

C. Recommend the use of pendant luminaires with "super" T-8 lamps (~0.9 watts/square foot) – no parabolic luminaires.
C. Every watt supplied to a space has to be removed to avoid heat gain (therefore, plan to add as little as possible).
C. Recommend investigating the use of displacement ventilation.
Q. What is the recommended number of foot-candles for class rooms?

A. 40-50 FC
Q. Must the supply air in displacement ventilation be dehumidified?
A. Yes.

Steve Meder, UHSoA. "Guidelines for Cooling Portable Classrooms in Hawaii"
See attached presentation.

Charles Eley, Eley Associates. "Case Study on Results of Enhanced Environments"
See attached presentation.

Sam Nichols, HECO. "Hawaii Smart Schools Program"
This is the second year of the program and it is now in Phase 2.

1. Physical science students are taught about EE and how to conduct an energy audit;
2. Students create PowerPoint presentations of their results (of energy audit of their school) to inform school administrators of potential(s) for savings;
3. They market their lighting audit skills to local businesses, conducted audits and provided reports to participating businesses on how much could be saved by implementing audit recommendations.
4. Maui Community College students audited 32 Maui schools for a benchmarking study.

WORKING GROUP SESSION ONE: FEEDBACK ON KAPOLEI HIGH SCHOOL

(Q = Question, A = Answer, C = Comment, R = Recommendation)

Charles Eley comments:
General comments about Kapolei High School:
C. Centralized AC plant with chillers rotated for efficiency.
C. Only the multipurpose room (MPR) appeared to be un-AC'd.
C. All chiller plant equipment located indoors.
C. EE lighting, but little or no daylighting.
C. MPR ceiling fans mounted high in room; louvered vents located at top of walls.

Comments about MPR ventilation:
R. To improve natural ventilation, use stack height (chimney) phenomenon to ventilate the building by installing a monitor or clerestory device at ridgeline of roof.
C. Drop the ceiling fans further down, closer to the occupants.

A. HDOE responded that their policy has been to avoid roof penetrations for security and maintenance reasons. Problems have been encountered with roof leaks, too.

Q. What would be the reaction (of HDOE or DAGS) to (school architectural) plans with lots of skylights?

A. Uproar from DAGS Central Services Division (responsible for maintenance).

Q. What if security and leakage questions could be addressed?

A. Maintenance history remains a problem; there are also orientation problems – for instance, with a monitor or clerestory windows, north facing orientations may allow trade winds to drive in rain.

C. Solid glass panes could be installed on such north faces and louvers on the south side.

A. Another problem is that most of the buildings have flat roofs with slopes of less than 1/2".

Comments about lighting:

C. No occupancy sensors in existing HDOE facilities.

C. One sensor plus wiring adds $500-1,000.00 per classroom; if they shut off lights for 15-30 minutes/day, payback occurs in approximately 3 years. If they shut off the lights for 1hr/day, payback is about 9 months.

C. Occupancy sensors are an easy retrofit option.

A. Vandalism is an issue.

R. Use only ceiling mounted sensors (this also eliminates the possibility of the sensor being blocked by something in the room – e.g., an easel).

Q. How much adjustment is needed and how is it done?

A. Sensors have two adjustments, (1) sensitivity – designed to detect body heat radiation (passive infrared), so set to detect body temperature; and (2) time delay – usually 15-20 minutes for classrooms, this is the time between when the sensor no longer detects body heat and it shuts off the lights. The adjustments are made with a screwdriver.

Q. What is the lifecycle of these sensors?

A. Not sure, but 10-15 years.

C. There is an issue about turning on/off lights, it may decrease lamp life. Therefore, in new construction, "soft start ballasts" should be installed. The rated lamp life using these ballasts is approximately 30,000 hours and should offset or eliminate the problem.

C. Annual energy budget for all Hawaii schools, $22M/year.

Q. Are there HECO rebates for sensors?

A. Yes.

Q. Is there a specification in the ED SPEC for sensors, if not, is that why they aren't a standard feature?

C. Charles Eley has a spec that he can provide to HDOE. There are a number of manufacturers including Watts Stopper, Lutron and others. His is an open spec that allows for multiple competitors and keeps down costs.

Q. How to avoid conflict with ballasts and power line carrier communication systems such as alarms and LANS?

A. Hard wire the systems – the ballast has a capacitor that captures the signal.

R. Fluorescent lights are definitely the way to go. T-5's now 5/8" diameter and new luminaires have spectral above and clear lens below allowing optics that are good for high bay installations (to replace metal halides). They are very EE at 90-95 lumens/watt (metal halides run about 80 lumens/watt).

C. T-5 should be used in new fixtures; T-8's in retrofits.

C. T-5 can be turned on/off quickly, this is not true for metal halides.

C. "Super" T-8 (the new T-8) provide 90-100 lumens/watt and a low ballast factor ballast should be used to avoid driving the lamp at its full potential.

Comments regarding HVAC considerations:

C. Displacement ventilation (DV) has been used in Europe for approximately 30 years and more recently in offices in the USA. In the US, often installed as part of a raised floor (versus dropped ceiling) and office wiring is run through the pressurized floor plenum. This makes wiring retrofits very simple. H.L. Turner has pioneered the use of these systems in schools in Maine and New Hampshire over the last five years. However, it is not necessary to use a raised floor. Ducting can be applied to the exterior sheath of the building and plenum boxes installed low on exterior walls (at or near floor level) – under a window, for instance. Usually, two opposing corners will be used, however, four corners would provide better coverage.

The face velocity is very low (100 feet/min) and a very large grill is used on the supply register (six square feet or larger).

The DV system is extremely EE for a number of reasons:

1. Fans deliver ~1/2 air volume of normal HVAC system
2. Air is only conditioned to 65^{o}F (versus 55^{o}F)
3. Air can be dehumidified using EE heat exchanger/reheat system (commercially available) – this also acts to "pre-cool" fresh air intake. Dechamps sells an enthalpy wheel system, but it is very large.

C. It would be too expensive to use gas to dehumidify conditioned air, making desiccants impractical.

C. The DV is a "once through" system and flow-through should be controlled at the classroom.

Q. Is there a problem with people perceiving that the air is "stagnant"?

Q. Are there "immediacy" problems because the system takes longer to cool the space?

A. The DV system has a number of advantages:

1. It is extremely quiet.

2. The DV system is more effective at removing heat from the space because it does not rely on mixing of the air column to condition the space.

Q. Do you have to replace the filters more often (because it is one pass)?

A. No, the 400 CFM of make-up air is the same (so actually, you eliminate the need for return air filters).

Q. Are there limitations on furniture layout?

A. Other than things like bookcases or panels blocking the supply registers, no, things like desks shouldn't be a problem.

Q. What about kids either sitting or laying on the floor?

Q. How is the difference between latent and sensible heat load determined?

A. The Heat Load calculation is different for the DV scheme. Normally, a factor of 15% is used for lights, 30% for occupants and 30% for equipment (e.g., computers). But with DV, there is no mixing of the air column, so heat loads are determined using computational fluid dynamics. There is an ASHRAE (American Society of Heating, Refrigerating and Air-Conditioning Engineers) standard, done for clean rooms, that models this.

Q. Does the activity level of occupants affect DV cooling?

A. Yes, that is why each room should be equipped with a variable air volume control feature.

Insulation comments.

R. Radiant barriers should be used to keep the heat out.

C. Old schools have flat, built-up roofs.

R. Use single ply membranes that are highly reflective to decrease solar gain through the roof.

C. Since flat roofs also have a higher potential for moisture intrusion and mold growth (due to pooling of rain water), it is a good idea to design in a small pitch (at least).

C. Radiant barriers are cost effective and now manufacturers of oriented stand board (OSB) are producing OSB with the radiant barrier already attached to one side (the "down" side) – it only adds $0.10-0.15/square foot.

SESSION TWO: PRE-ENGINEERED SOLUTIONS

HDOE's "wish list":

1. Daylighting – in two projects, daylighting didn't make it out of the first phase of design because the consultant said it was too costly. Local architects don't seem to be comfortable with or able to come up with cost effective daylighting designs. HDOE would like to be able to have daylighting as an option.
2. Air Conditioning – is it being done efficiently? HDOE has been relying on consultants and is looking for better AC models or other options to AC.

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Comments on other AC solutions.

Q. Should AC be required or should there be a blanket ventilation strategy for most locations?

C. The use of radiant barriers in conjunction with natural ventilation and wall insulation worked for DBEDT in a project with the Department of Hawaiian Homelands to construct and EE house. The house was so cool that visitors were fooled into thinking that it was AC'd.

C. Historically, no schools in Hawaii were AC'd. Now, AC and operable windows are in demand.

C. HDOE policy is that certain rooms (music/band, libraries, year around multi-track schools, and those with high external noise levels) be AC'd.

Under Policy 6700, schools can request that additional rooms be AC'd – for instance, computer rooms.

Noise and or heat abatement program has been implemented to address problem schools.

There is considerable political pressure to AC certain schools.

HDOE has been requesting the installation of dehumidifiers in libraries, but currently, there are insufficient units in place.

Q. What are HDOE's options to avoid AC? Of 230 schools, 180 are eligible for AC.

Q. How does HDOE get designers to accept daylighting? Is there some way to quantitatively validate the educational improvement claims of daylighting?

A. Yes, the educational benefits were documented by Lisa Heschong of Heschong-Mahone Group in a study commissioned by Pacific Gas and Electric.

C. Act 77 mandates a 20% reduction in energy consumption by state facilities. It requires a lifecycle analysis to determine cost-benefit.

C. The USDOE and DBEDT are conducting two, two-day workshops in February, 2003, on lifecycle costing. Both workshops are already full, but more will be scheduled.

Q. If "we" want HPS, what will it take to get them?

C. Consultants don't seem to understand what it takes, either.

C. A core of consultants does understand, but the state is unable to hire them either for financial or other reasons. The expertise exists in the state. The contracting process is defective.

Q. Won't changing the bid specifications take care of that problem?

C. DAGS is not a client of choice. DAGS needs to be able to ask for cost effective solutions to design requests, like daylighting, desired by HDOE.

RETROFITTING PORTABLE CLASSROOMS

C. It is the perception of architecture and design professionals that HDOE and DAGS don't want EE buildings.
C. Lifecycle cost is the only way to look at it – it isn't just up front costs or maintenance costs.
C. There are time and money constraints on the process. Kapolei High School was different because there was an agreement with the developer – there was more leeway to get different ideas incorporated.
C. If HDOE mandated it, DAGS would have to do it – but up front costs always win in the end (unless evaluation techniques were modified to utilize Life Cycle Costing).
Q. Is there a model available to cost out HPS options versus conventional school designs?
A. Individual items (e.g., high performance windows, occupancy sensors, daylighting, etc.) – yes. Lifecycle analysis doesn't need to be a complicated process. In CHPS, it was determined that saving 1 kilowatt hour per year amounted to a $2.00 savings. Thus, if you saved 1,000 KW per hr, you could spend the $2,000.00 savings on something else.
C. It becomes difficult with items that have differing maintenance costs.
C. It would be better if budgeting process at DAGS was changed so that all money for schools was administered through one office (that is, money for renovations and maintenance).
C. DAGS Central Services has a six-year plan with HDOE.
Q. Where could funding come from for additional portable classroom studies?
A. The federal government (USDOE) through state and utility.
Q. How did CHPS fund PG&E study?
A. USDOE and PG&E.
C. HECO has money to fund energy analysis (lifecycle) studies for new construction alternatives and for retrofits (retrofits at 1/2 cost of study up to $10,000/meter). It takes filling out a form, submitting it to HECO and engaging in a planning meeting. The school is modeled on computer and a report is generated.
C. It seems that there is a problem in having DAGS functions separated into operations/maintenance and renovations.
C. There is a conflict in DAGS – but can the money be leveraged somehow – like using the savings to pay off bond? That would require DAGS operations money to go back to the construction side… could this be worked out?
C. There has to be a financial instrument to pay off the marginal cost difference.
A. Act 77 states that utility cost savings will not be used to decrease the utility budget appropriation– this funding remains at the level pre-savings (plus

inflation). The difference can be kept and used to pay for the up front costs of EE alternatives.

A. Yes, but because it is two different departments, the savings don't go back to the correct department.

Q. If HDOE is to obtain HPS, what has to be in the ED SPEC to achieve this?

A. Just tell DAGS, they will amend "Design Consultants Criteria Manual" that is currently in production.

A. In Volume 3 of the CHPS manuals is "Criteria". This manual identifies 81 "points" of which a building/facility must accrue 28 "points" to qualify as a HPS. There are also basic criteria that all HPS must meet, too. For instance, all sites must be subjected to a Phase I site assessment to ensure that there are no toxic materials contaminating the site.

C. Perhaps HDOE could use the LEEDS model of using sustainability consultants.

Q. Will there be a performance standard for retrofits that is included in the bid package? Should it parallel the LEED criteria? Should it be prescriptive?

Q How does HDOE currently end up with the building it wants? Criteria are out there, but how can the obstacles (already mentioned, like value engineering and funding difficulties) be gotten around?

C. The time constraint of plan/design/construct within two years is a big problem.

C. Retrofits can include anything – so guidelines would have to be keyed to each project – some would require additional guidelines, some would only use a single guideline. For instance, if a retrofit is for AC, guidelines consulted would have to deal with insulation, windows, radiant barriers, etc.

C. Right now, the Scope is written directly, as number of classrooms of each given type – but NOT QUALITY (e.g., HPS quality).

R. Ask DAGS to accompany HDOE in making a needs assessment for elements of future retrofits – co-inspect campus to evaluate needs.

C. There is currently a $600M backlog of retrofit work.

C. The LEED certification process requires a "commissioning authority" to be appointed to act as a watchdog and peer-reviews to occur during the certification to ensure that RFP criteria are met – perhaps HDOE could adopt a LEED-like process of overview or project management?

C. We don't have to guess about good retrofit design, it can be a rational process.

C. DAGS oversees 25-30 new portable installations a year. These have been slab-on-grade because of ADA (Americans with Disabilities Act) and hurricane safety requirements. DAGS is looking at going back to truly modular portables that can actually be moved, but they are finding it expensive.

C. Simply installing Astrofoil® or insulation, if it isn't finished correctly, isn't enough. Product needs to be finished, complete with architectural finishes.

Q. How much does a portable cost?

A. $120,000 for an 810 square foot portable – which is the functional cost, that is, it is ready to use – plumbed with a sink, lights, electricity, and ceiling fans.

C. The (lifecycle) cost difference between renovation and replacement needs to be taken into account.

C. Open bids have not beaten the “stick-built” price that DAGS has now.

C. HDOE has evaluated five types of modulars built using foam core. They are a vast improvement over current stock.

C. HDOE needs a truly portable “portable.”

Presentations

Overview

Charles Eley, FAIA, PE
Eley Associates

the collaborative for high performance schools

Overview

What is a High Performance School?

the collaborative for high performance schools

What Is a High Performance School?

- Healthy
- Comfortable
  - Thermally
  - Visually
  - Acoustically
- Efficient
  - Energy
  - Materials
  - Water
- Easy to Maintain and Operate
- Commissioned
- Environmentally Responsive
- A Teaching Tool
- Safe and Secure
- A Community Resource
- Stimulating Architecture

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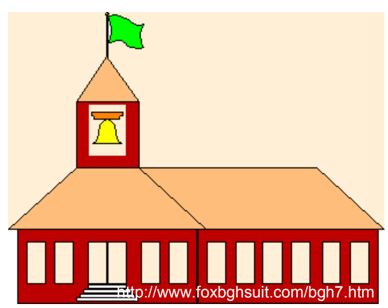

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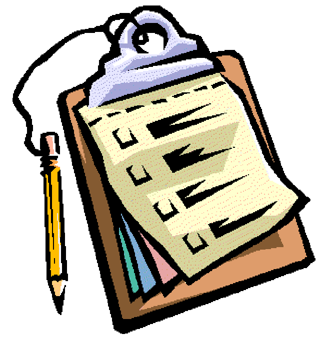

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http://www.tropicana.com/biz/about/environ.htm

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Why Are High Performance Schools Important?

- Increased Student Learning and Teacher Performance.
- Increased Average Daily Attendance (ADA).
- Increased Teacher Satisfaction and Retention.
- Reduced Operating Cost.
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- Reduced Liability.
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http://alldesign.com/benefits.htm

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Myth 1: High Performance Schools are Not Cost Effective

- High performance schools do not have to cost more, with integrated design.
- Incentive programs exist to help offset incremental costs.
- Healthier environments increase average daily attendance (ADA), and therefore funding.
- On a life-cycle cost basis, high performance schools are highly cost effective. Energy and resource efficiency can save up to 30% on utility bills.

Long Term Costs of School Operation

- Over 30 years, the initial cost of construction is almost insignificant.
  - 2% for construction costs
  - 6% for operations and maintenance
  - 92% for labor
- Therefore, it pays to create healthy and comfortable environments.

Source Joe Rohm, USDOE

Myth 2: High Performance Schools Take Longer to Design and Construct

- Timelines are short, but better design does not have to be a roadblock.
- Districts must identify their goals early and communicate them clearly with the design team.
- Hire design teams familiar with high performance design concepts.
- The CHPS Criteria is a scoring system for identifying your high performance goals.

Myth 3: District Leaders have to be Experts in High Performance Design

- CHPS tools can help school districts manage the process from goal setting through construction.
- Require design teams and contractors to meet the CHPS Criteria.
- It's the architect's and engineer's role to make sure the criteria are satisfied, but monitor progress toward meeting the goals.

Myth 4: High Performance Schools Require Need More Maintenance And Are Difficult To Operate

- All schools, from traditional to high performance buildings, require regular maintenance to ensure they perform as designed. Health, comfort, and efficiency can all be compromised without adequate maintenance.
- High performance design does not mean using overly complicated, maintenance intensive systems.
- Rather they are based on a design philosophy that integrates the building systems under a common goal to create the best facility for your budget and the unique constraints of the district.

Overview

Programs & Resources

the collaborative for high performance schools

Best Practices Manual Organization

- Volume I – Planning
  - Descriptive and process information for school districts, superintendents, board members, and others.

- Volume II – Design
  - Detailed technical information and guidelines for architects, engineers, school planners, contractors and other building professionals.

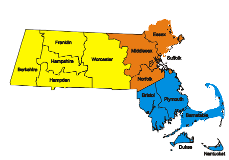
- Volume III – Criteria
  - A flexible “yardstick” for measuring whether or not a school qualifies as “high performance”.

- Volume IV – Operations and Maintenance
  - Being developed now. Expected to be ready in Spring of 2003.

Best Practices Manual Versions

California Version

National Best Practices Manual – EnergySmart Schools Program



Massachusetts Version

Organization of National Best Practices Manual

- ***Introduction to the Guidelines***
- ***Site Design***
- ***Daylighting and Windows***
- ***Energy-Efficient Building Shell***
- ***Lighting and Electrical Systems***
- ***Mechanical and Ventilation Systems***
- ***Renewable Energy Systems***
- ***Water Conservation***
- ***Recycling Systems and Waste Management***
- ***Transportation***
- ***Resource-Efficient Building Products***
- ***Commissioning and Maintenance***

Anatomy of a Guideline

- Recommendation
- Description
- Applicability
- Integrated Design Implications
- Costs
- Benefits
- Design Tools
- Design Details
- Operations and Maintenance Issues
- Commissioning
- References/Additional Info

GUIDELINE SD6: LANDSCAPING SOIL, AMENDMENTS, AND MULCH

Recommendation

Use organic soil amendments to help restore the health of disturbed soils. Where feasible and appropriate, use soil amendments and mulch with recycled content.

Description

The appropriate use of organic soil amendment will offset degradation in soil health due to construction activities, reduce runoff, help treat stormwater pollutants, and help ensure establishment of vegetation. Where feasible, use soil amendments from composted green waste and mulch from shredded bark, which adheres better to the soil.

Applicability

All climates.

Integrated Design Implications

Soil amending should be integrated/coordinated with Guideline SD2: Landscaping to Provide Shade to HVAC Systems, Buildings, and Paved Areas; Guideline SD3: Landscape Design and Management; and Guideline SD5: Native and Drought-Tolerant Plants.

Cost Effectiveness

Medium.

Benefits

Research at the University of Washington has shown that, compared to traditional lawn installations, landscape grown on composted-amended soils:

- Uses less water for irrigation.
- Requires less fertilizer and pesticide.
- Covers and 'greens up' more quickly.
- Has improved appearance.
- Reduces stormwater runoff.

Design Tools

Appropriate use of soil amendments requires site soil testing and analysis to determine type and amount of amendment.

Site Design

- *Overview*
- *Guideline SD1: Optimum Building Orientation*
- *Guideline SD2: Landscaping to Provide Shade to HVAC Equipment, Buildings, and Paved Areas*
- *Guideline SD3: Landscape Design and Management*
- *Guideline SD4: Impervious Surfaces*
- *Guideline SD5: Native and Drought-Tolerant Plants*
- *Guideline SD6: Landscaping Soil, Amendments, and Mulch*
- *Guideline SD7: Integrated Weed, Disease, and Pest Management*
- *Guideline SD8: Environmentally Responsible Job-site Management*
- *Guideline SD9: Indoor Air Quality During Construction*
- *Guideline SD10: Site Protection During Construction*

Daylighting and Windows

- *Overview*
- *Guideline DL1: View Windows*
- *Guideline DL2: High Sidelighting – Clerestory*
- *Guideline DL3: High Sidelighting – Clerestory with Light Shelf or Louvers*
- *Guideline DL4: Classroom Daylighting – Wall Wash Toplighting*
- *Guideline DL5: Central Toplighting*
- *Guideline DL6: Patterned Toplighting*
- *Guideline DL7: Linear Toplighting*
- *Guideline DL8: Tubular Skylights*

Energy-Efficient Building Shell

- *Overview*
- *Guideline EB1: Wall Insulation*
- *Guideline EB2: Roof Insulation*
- *Guideline EB3: Cool Roofs*
- *Guideline EB4: Radiant Barriers*
- *Guideline EB5: Air Barriers and Other Methods to Reduce Infiltration*
- *Guideline EB6: Concrete Masonry*

Lighting and Electrical Systems

- *Overview*
- *Guideline EL1: Pendant-Mounted Lighting*
- *Guideline EL2: Troffer Lighting*
- *Guideline EL3: Industrial-Style Classrooms*
- *Guideline EL4: Lighting Controls for Classrooms*
- *Guideline EL5: Gym Lighting*
- *Guideline EL6: Corridor Lighting*
- *Guideline EL7: Lighting for a Multi-Purpose Room*
- *Guideline EL8: Lighting for a Library or Media Center*
- *Guideline EL9: Lighting for Offices and Teacher Support Rooms*
- *Guideline EL10: Lighting for Locker and Toilet Rooms*
- *Guideline EL11: Outdoor Lighting*

Mechanical and Ventilation Systems

- *Overview*
- *Guideline MV1: Cross Ventilation*
- *Guideline MV2: Stack Ventilation*
- *Guideline MV3: Ceiling Fans*
- *Guideline MV4: Gas/Electric Split System*
- *Guideline MV5: Packaged Rooftop System*
- *Guideline MV6: Displacement Ventilation System*
- *Guideline MV7: Hydronic Ceiling Panel System*
- *Guideline MV8: Unit Ventilator System*
- *Guideline MV9: Ductless Split System*
- *Guideline MV10: Evaporative Cooling System*
- *Guideline MV11: VAV Reheat System*
- *Guideline MV12: Radiant Slab System*
- *Guideline MV13: Baseboard Heating System*
- *Guideline MV14: Gas-Fired Radiant Heating System*
- *Guideline MV15: Water-Loop Heat Pumps*

Mechanical and Ventilation Systems (cont.)

- *Guideline MV16: Evaporatively Precooled Condenser*
- *Guideline MV17: Dedicated Outside Air Systems*
- *Guideline MV18: Economizers*
- *Guideline MV19: Air Distribution Design Guidelines*
- *Guideline MV20: Duct Sealing and Insulation*
- *Guideline MV21: Hydronic Distribution*
- *Guideline MV22: Chilled Water Plants*
- *Guideline MV23: Boilers*
- *Guideline MV24: Adjustable Thermostats*
- *Guideline MV25: EMS/DDC*
- *Guideline MV26: Demand Controlled Ventilation*
- *Guideline MV27: CO Sensors for Garage Exhaust Fans*
- *Guideline MV28: Timers for Recirculating Hot Water Systems*

Renewable Energy Systems

- ***Overview***
- ***Guideline RE1: Passive Heating and Cooling***
- ***Guideline RE2: Solar Thermal Hot Water Systems***
- ***Guideline RE3: Solar Pool Heating***
- ***Guideline RE4: Wind***
- ***Guideline RE5: Geothermal Heat Pumps***
- ***Guideline RE6: Photovoltaics***

Water Conservation

- ***Overview***
- ***Guideline WC1: Water-Efficient Irrigation Systems***
- ***Guideline WC2: Stormwater Management, Groundwater Management, and Drainage Materials***
- ***Guideline WC3: Rainwater Collection Systems***
- ***Guideline WC4: Gray Water Systems***
- ***Guideline WC5: Waterless Urinals***
- ***Guideline WC6: Efficient Terminal Devices***

Recycling Systems and Waste Management

- *Overview*
- *Guideline RS1: Paper, Plastics, Glass, and Aluminum Recycling*
- *Guideline RS2: Composting*
- *Guideline RS3: Construction and Demolition (C&D) Waste Management*

Transportation

- *Overview*
- *Guideline TR1: Transportation and Site Design*
- *Guideline TR2: Alternative Fuel Vehicles*

Resource-Efficient Building Products

- *Overview*
- *Guideline BP1: Carpeting*
- *Guideline BP2: Resilient Flooring*
- *Guideline BP3: Ceramic Tile / Terrazzo*
- *Guideline BP4: Concrete Flooring*
- *Guideline BP5: Wood Flooring*
- *Guideline BP6: Bamboo Flooring*
- *Guideline BP7: Gypsum Board*
- *Guideline BP8: Acoustical Wall Panels and Ceilings*
- *Guideline BP9: Paints and Coatings*
- *Guideline BP10: Casework and Trim*
- *Guideline BP11: Interior Doors*
- *Guideline BP12: Toilet Partitions*

Commissioning and Maintenance

- *Introduction*
- *What Exactly is Building Commissioning?*
- *Commissioning Approaches*
- *Benefits of Commissioning*
- *Costs of Building Commissioning*
- *Savings from Building Commissioning*
- *Selecting a Commissioning Provider*
- *The Commissioning Team*
- *Commissioning Phases*
- *Operation and Maintenance for Persistence*
- *List of Commissioning References and Resources*

Volume II: Daylighting

CHPS, Inc.

- Overview
- Guideline DL1: View Windows
- Guideline DL2: High Sidelighting—Clerestory
- Guideline DL3: High Sidelighting—Clerestory with Light Shelf or Louvers
- Guideline DL4: Classroom Daylighting—Wall Wash Top Lighting
- Guideline DL5: Central Toplighting
- Guideline DL6: Patterned Toplighting
- Guideline DL7: Linear Toplighting
- Guideline DL8: Tubular Skylights

Volume II - Design 41

Volume II: Building Envelope and Insulation

CHPS, Inc.

- Overview
- Guideline IN1: Wall Insulation
- Guideline IN2: Roof Insulation
- Guideline IN3: Cool Roofs
- Guideline IN4: Radiant Barriers
- Guideline IN5: Reduce Infiltration

Volume II - Design 42

Volume II: HVAC

Guideline

CHPS, Inc.

- Overview
- Guideline TC1: Cross Ventilation
- Guideline TC2: Stack Ventilation
- Guideline TC3: Ceiling Fans
- Guideline TC4: Gas/Electric Split System
- Guideline TC5: Packaged Rooftop System
- Guideline TC6: Displacement Ventilation System
- Guideline TC7: Hydronic Ceiling Panel System
- Guideline TC8: Unit Ventilator System
- Guideline TC9: Ductless Split System
- Guideline TC10: Evaporative Cooling System
- Guideline TC11: VAV Reheat System
- Guideline TC12: Radiant Slab System
- Guideline TC13: Baseboard Heating System

Volume II - Design 43

Volume II: HVAC (cont'd)

Guideline

CHPS, Inc.

- Guideline TC14: Gas-Fired Radiant Heating System
- Guideline TC15: Evaporatively Precooled Condenser
- Guideline TC16: Dedicated Outside Air Systems
- Guideline TC17: Economizers
- Guideline TC18: Air Distribution Design Guidelines
- Guideline TC19: Duct Sealing and Insulation
- Guideline TC20: Hydronic Distribution
- Guideline TC21: Chilled Water Plants
- Guideline TC22: Hot Water Supply
- Guideline TC23: Adjustable Thermostats
- Guideline TC24: EMS/DDC
- Guideline TC25: Demand Controlled Ventilation
- Guideline TC26: CO Sensors for Garage Exhaust Fans

Volume II - Design 44

Volume II: Other systems

Guideline

CHPS, Inc.

- Overview
- Guideline OS1: Photovoltaics
- Guideline OS2: Solar Pool Heating
- Guideline OS3: Rainwater Collection Systems
- Guideline OS4: Gray Water Systems
- Guideline OS5: Timers for Recirculating Hot Water Systems
- Guideline OS6: Efficient Terminal Devices
- Guideline OS7: Waterless Urinals
- Guideline OS8: Relocatable Classrooms

Volume II - Design

Volume III: Recommended Credits (cont'd)

Criteria

CHPS, Inc.

- Commissioning and Training. All schools should be commissioned to ensure that the design meets the expectations of the district, and that the school is built as it was designed.
  - Energy Credit 4: Commissioning (2-3 points).
- Acoustics. If not controlled, poor acoustics can significantly impede student learning.
  - IEQ Credit 5: Improved Acoustical Performance (2 points).
- Sustainable Materials. Alternatives exist for most building surfaces and should be used as much as possible.
  - Materials Credit 4: Recycled Content (1-2 points).
  - Materials Credit 6: Certified Wood (1 point).
- Waste Reduction. It is now possible to recycle, compost, or salvage a majority of construction and demolition waste instead of disposing it in landfills.
  - Materials Credit 1: Site Waste Management (1-2 points).

Volume III - Criteria

Overview

The CHPS Classroom

the collaborative for high performance schools

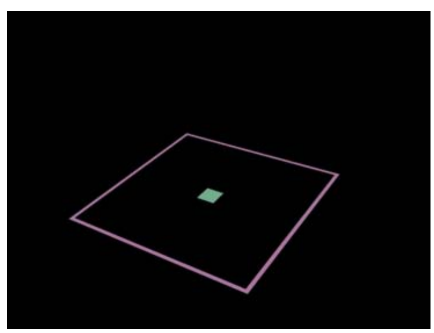
The CHPS Classroom

Goals of a High Performance Classroom

- Visual, thermal and acoustic comfort.
- Good outside air ventilation.
- Excellent indoor air quality.
- Energy, material, and water efficiency.
- Provide a lesson on sustainable design.

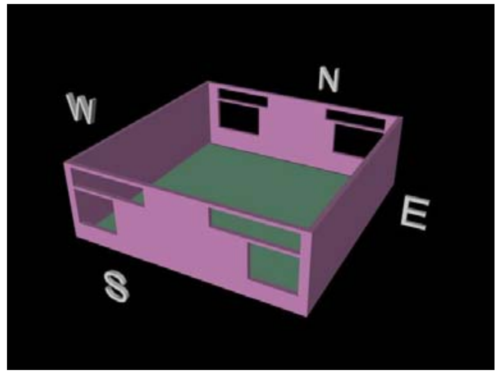
High Ceilings

- Average classroom is 30’ x 30’.
- High ceilings enhance space and provide better illumination, ventilation. and acoustics.
- Floor-to-ceiling height should be at least 10’.



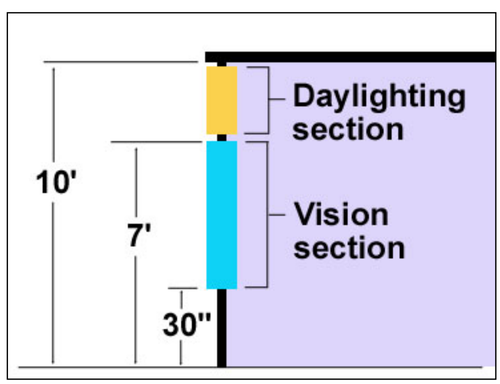
Orient Windows North/South

- Windows should be oriented either north or south.
- Locate windows at edges of room to prevent dark corners and wash teaching wall.



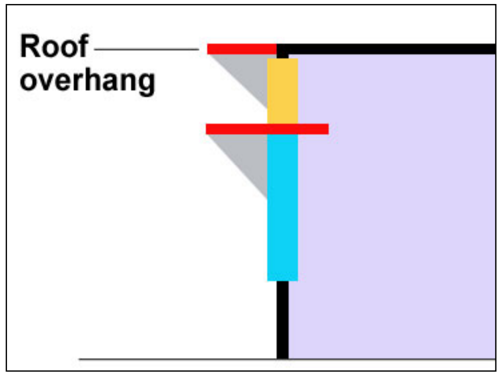
Window Sections

- Daylighting section allows sunlight in to illuminate room.
- Vision section glass should be double glazed and should be operable.



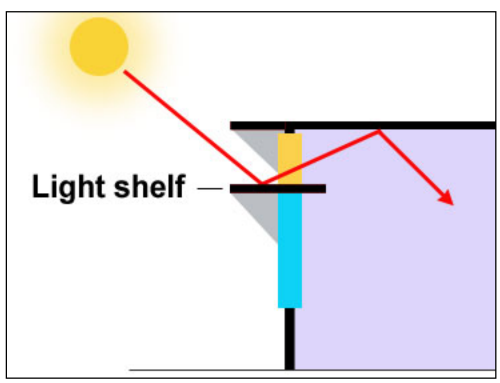
Roof Overhangs

- Overhangs should be added to south-facing windows to prevent glare and to reduce solar heat gain.



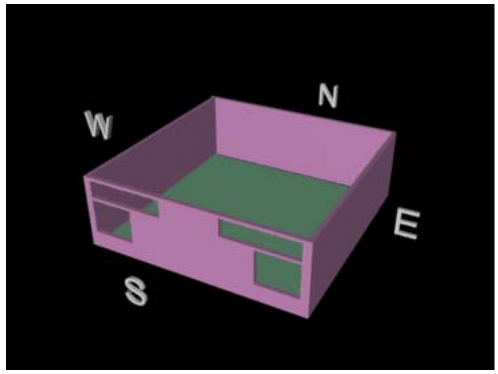
Light Shelves

- A light shelf should be added to reflect light onto the ceiling and into classroom.
- Light shelf also acts to shade the vision section of the window.



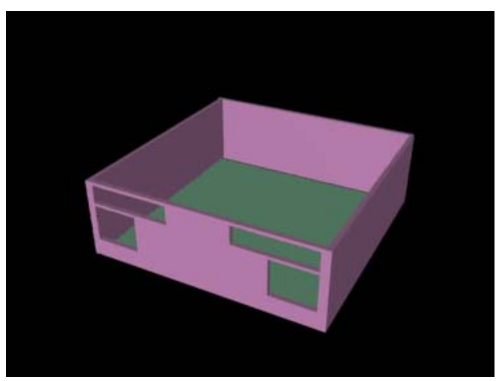
Skylights

- Skylights or clearstories should be used to illuminate the back wall of the classroom. Light shelf also acts to shade the vision section of the window.
- Use skylights with glazing to diffuse light.



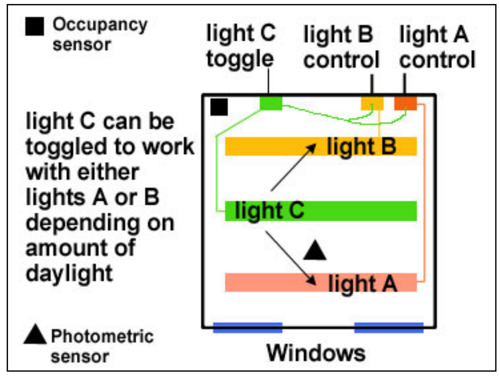
Electric Lighting

- Three rows of pendant-mounted electric lights are positioned parallel to the window wall.



Lighting Control

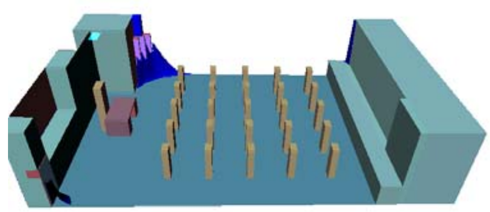
- Occupancy sensors shut off lights if room is unoccupied.
- Separate controls for each light based on daylighting availability.



The CHPS Classroom 57

Displacement Ventilation

- Fresh cool air is slowly supplied near the floor.
- Air rises as it warms.
- Air is exhausted near the ceiling.



Courtesy H. L. Turner Group

The CHPS Classroom 58

Furnishings & Materials

- Choose flooring materials that are resource efficient.
- Avoid particle board.
- Use low-emitting paint and adhesives, and apply them before installation of carpet or ceiling tiles.
- Ceilings and upper walls should be light in color with 80%+ reflectance.

Overview

Productivity Anecdotes

the collaborative for high performance schools

WalMart

- Prototype store in Lawrence, Kansas with skylights
- Sales "significantly" higher in areas with skylights
- Employees try to have their departments moved to the daylighted areas

Nederlandsche Middenstandsbank

- No desk more than 23 ft from window
- Absenteeism dropped 15%

ICU Stanford Hospital

- “Artificial” windows installed at a cost of $1,000/ft2
- Patients hospitalized for shorter periods
- Complained less
- Required less pain medication
- Considered to be well worth the cost

Daylighting and Electric Lighting

Daylighting Overview

the collaborative for high performance schools

What is Daylighting?

- Designing spaces to use diffuse light from the sky.
- Use daylighting to provide the PRIMARY illumination within a space.
- Design the electric lighting system to SUPPLEMENT the daylight.
  - Make sure it is turned off when not needed.
  - Provide adequate light when no daylight is available.
- May involve mechanical controls to reduce glare and to deal with low solar angles.

What is NOT Daylighting?

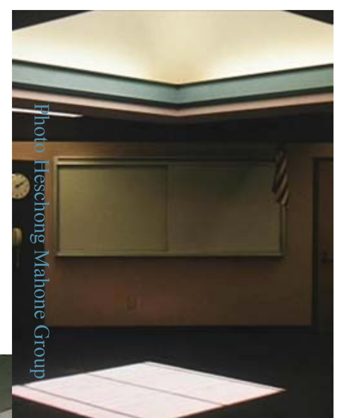
- Incorrectly designed windows and or skylights.
  - Any building with windows.
  - A building with too many windows.
- A building designed for passive solar heating (usually too much glare).
- A building with good daylight illumination BUT the electric lights burning away.

7

Sunlight is NOT daylight

- Too bright.
- Too hot.
- Creates glare.
- Prevent sunlight penetration anywhere people can't move away from it.
- Sunlight "patches" can pleasantly animate circulation spaces.

Glare From Skylight



Glare from Window

8

A Brief History of School Windows

- 50 years ago all schools (and workplaces) were daylighted.
- 40 years ago, the State Architect to reviewed all new school plans for appropriate daylight design.
- In the late 60’s and 70’s windows began to be considered:
  - A distraction for children.
  - A energy liability.
  - A maintenance liability.
  - A security liability.
- The “Open Classroom” of the 70’s was often a windowless classroom, in a big open plan building.
- “Energy efficiency” retrofits have often removed daylight.

9

A Fresno Elementary School, circa 1965

A Fresno Elementary School, circa 1985

40% of all FUSD Classrooms are Portables

"Energy Efficiency Retrofits," circa 1995

Photo Heschong Mahone Group

13

Photo Heschong Mahone Group

Over Glazing is the biggest,
***and* most common, mistake !**

14

Skylights – Simplest and Most Reliable

- Not if they are the right size!
- Less area for the same amount of daylight.
- Plus, skylights are:
  - Effective all day long.
  - Effective under sunlight or cloudy skies.
  - Inexpensive.
  - Relatively independent of building orientation.

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Summary of Daylighting Design Principles

- Allow NO sun penetration,
  - except in circulation spaces.
- Diffuse the light broadly through diffusing glazing and/or shading.
- Introduce daylight as high as possible,
  - and from more than one direction.
  - Two sides, top and side, etc.
- Use light colored surfaces.
- Keep brightest surfaces out of line of sight.
- Provide blinds or louvers where there is potential for glare or for audio-visual control.

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Oakridge High School: Daylight from Two Sides

17

Overview

PG&E Study

the collaborative for high performance schools

The Three School Districts:

- Are Very Different!
  - Seattle, Ft. Collins CO, Capistrano CA
  - 3 climate conditions
  - 3 curriculums & administration styles
  - Wide range of building styles:
    - finger plan, enclosed, 1-3 story
  - 3 testing protocols
  - 10 skylight / toplight conditions

Windows versus Skylights

- Districts chosen to include toplit classrooms
- Daylight from windows can also provide
  - view, information on time of day, weather
  - ventilation, heating and cooling impacts
  - status, morale boost, stress reduction
  - supervision/communication
  - display surface (esp. in elementary schools)
- Skylighting (or toplighting) is much simpler
  - allowing us to isolate a "daylight" effect

Capistrano Site Conditions

- Typical California one-story schools:
  - 50's daylit "finger plan"schools
  - 70's open plans (w/ no windows)
  - 5 types of skylights in 7 schools
  - package AC, retro AC, wall units
  - fixed and operable windows, clear or tinted
- Portables at all sites
  - 40% of classrooms
  - A variety of daylighting conditions within each school site

Capistrano School District

- Comparison of Spring to Fall Scores
  - NEA "Core Level"
    Customized Curriculum Based Tests
  - Measures about 8 months of progress
- Excellent demographic data
  - all identities masked
- **Some courageous administrators….**

50 Variables Examined in Model:

- **Physical Conditions**
  - Vintage
  - SF per school
  - Classroom Type
  - Daylight availability
  - Skylight type
  - Window area and tint
  - Operable Window
  - Air Conditioning type
- **School Site**
  (accounts for:)
  - PTA or staff morale at site
  - neighborhood, or special programs, or principal...
- **Grade Level**
- **Socioeconomic**
  - Free & reduced lunch clsrm %
  - Absences and tardies
  - Gifted and talented
  - English as a second language
  - Ethnicity
  - Gender
- **School and Class Size**
  - Students per class
  - Students per school
  - Bilingual program
  - Year round schedule

Capistrano
Window Code 1

Capistrano
Open Classroom
Window Code 2

Photo Heschong Mahone Group

Photo Heschong Mahone Group

Capistrano --
Open Classroom
Window Code 0

Capistrano

Portable Classroom

Window Code 1

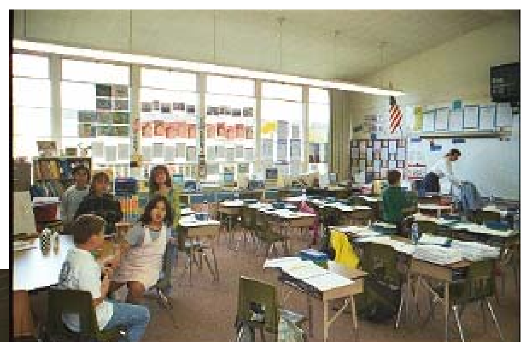
Daylight Code 2

Photos Heschong Mahone Group

Capistrano

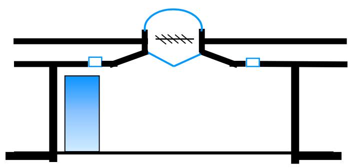
Single Loaded
Finger Plan School

Window Code 5

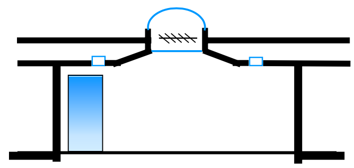


Photos Heschong Mahone Group

Skylight A



Skylight AA



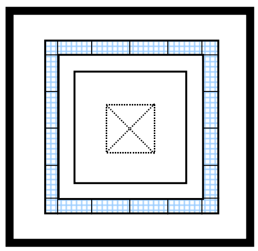
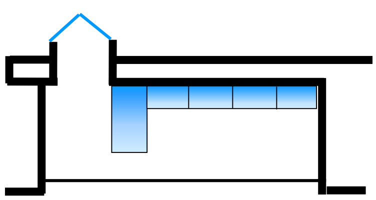
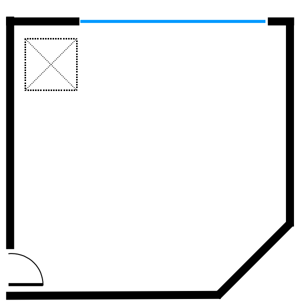


Photo PJHM Architects

Daylighting & Productivity 27

Skylight B





Photos Heschong Mahone Group

Daylighting & Productivity 28

Skylight C

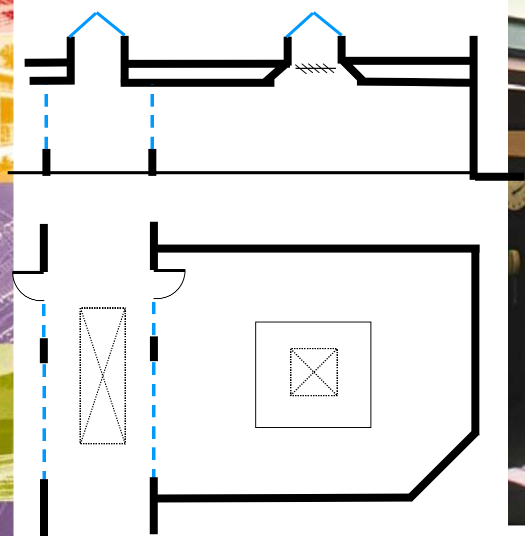


Photo Heschong Mahone Group

Capistrano Delta Regression

- Significant (beta order)
  - Grade Level
  - GATE
  - **Daylight Codes**
  - School Site
  - Students per School
  - Language Program
  - **Operable Windows**
  - # of Absences
- Not Significant
  - Ethnicity
  - Socio-Econ Status
  - Age of School
  - Gender
  - Number of Tardies
  - Air Conditioning
  - Year Round Sched.
  - Type of Classroom

Reports available from:

- www.pge.com
- www.h-m-g.com

EnergySmart Schools Overview

- ❖ Improve teaching and learning environments
- ❖ Reduce energy consumption and costs
- ❖ Increase use of clean energy
- ❖ Help schools reinvest energy savings
- ❖ Increase student, teacher,parent, and community awareness

EnergySmart Schools Opportunities

- ❖ **Technical Assistance**
- ❖ **Products and Services**
- ❖ **Educational Resources**

Technical Assistance in Action

- Use of ENERGY STAR evaluations to determine energy- savings potential with each district
- Use of DOE-2 energy simulation software to illustrate benefits of energy-efficient design.
- Participate in design charettes
- Conduct preliminary energy audit walk-throughs
- Help identify utility incentives for design support and equipment upgrades.
- Assist in performance contracting document review

Products

- Easy-to-use rating and benchmarking tools
- Climate specific *Energy Design Guidelines*
- *National Best Practices Manual for Building High Performance Schools*
- EnergySmart Schools Overview
- Energy-Smart Building Choices
- Myths about energy in Schools
- School Close-ups

Services

❖ State-based forums for school decision makers, architects and engineers

❖ *Designing High Performance Schools Workshops for Architects and Engineers*

❖ *High Performance School Buildings Workshops* for School Decision-makers

Educational Resources

❖ *Get Smart About Energy* CD-rom for Teachers

❖ Student activities on energy on EnergySmart Schools Web site

Contact EnergySmart Schools

✓www.energysmartschools.gov

✓www.rebuild.org

✓(800) DOE-EREC

✓patricia_plympton@nrel.gov

Energy Design Guidelines for High Performance Schools

Patricia Plympton

Products and Services Manager, EnergySmart Schools

National Renewable Energy Laboratory

Energy Consumption in U.S. Schools

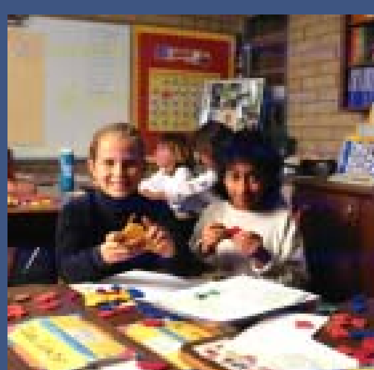
118,000 public and private K-12 schools nationwide:

- ✓ Spend $6 billion annually on utility bills - the largest budget item after teacher salaries
- ✓ Pay more for energy than they do for computers and textbooks combined
- ✓ Can reduce energy costs by 25-30% with energy-saving design tools
- ✓ Can redirect those savings back into the school

Benefits of High Performance Schools

- ✓ Enhanced learning environments
- ✓ “Healthier” buildings
- ✓ Reduced operating costs
- ✓ Buildings that “teach”

Goals of EnergySmart Schools



- ✓ Improve teaching and learning environments
- ✓ Reduce energy consumption and costs
- ✓ Increase use of renewable energy
- ✓ Help schools reinvest savings
- ✓ Educate students, teachers, parents, and the community about energy efficiency and renewable energy

High Performance Schools Design Products

- National Best Practices Manual for Building High Performance Schools
- Energy Design Guidelines for High Performance Schools for seven climate zones
- FY'03: 2 new Guidelines:
  - Tropical Island
  - Arctic Climates

A Collaborative Success

- Participation from representatives from over 40 states
- State Energy Officials
- Rebuild America Business Partners
- Rebuild America Products and Services Team
- School Architects and Engineers
- School Board Officials
- School Facility Planners and Managers
- U.S. DOE Regional Offices
- U.S. DOE National Laboratories
- U.S. Department of Education
- U.S. EPA
- School, Energy, and Education Non-profits

Organization of School Design Manuals

- Site Design
- Daylighting and Windows
- Energy-Efficient Building Shell
- Lighting and Electrical Systems
- Mechanical and Ventilation Systems
- Renewable Energy Systems
- Water Conservation
- Recycling and Waste Management
- Transportation
- Resource-Efficient Building Products
- High Performance Checklist
- Case Studies

Energy Design Guidelines

Establish High Performance Goals

Improve Academic Performance

Protect Our Environment

Reduce Operating Costs

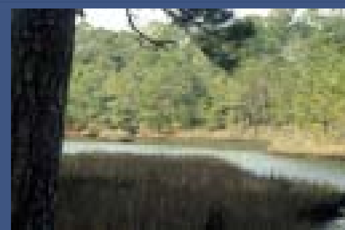
Design for Health, Safety, and Comfort

Design Buildings That Teach

Support Community Values

Site Design

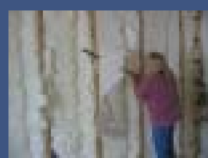
- ❖Selecting a Site
- ❖Protecting Local Ecosystems
- ❖Water-Conserving Strategies
- ❖Erosion Control, Off-Site Impacts
- ❖Building Orientation
- ❖Renewable Energy
- ❖Maximize the Potential of the Site
- ❖Connecting School to Community



Daylighting and Windows

- ❖Building Orientation and Solar Access
- ❖Daylighting Strategies
- ❖Roof Monitors and Clerestories
- ❖Lightshelves
- ❖Lighting Controls
- ❖Interior Finishes
- ❖Appropriate Choice for Windows
- ❖Exterior Window Treatments
- ❖Interior Window Treatments
- ❖Skylights

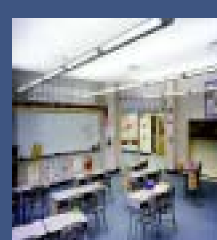
Energy-Efficient Building Shell



- ❖Stopping Radiant Heat Gains
- ❖Insulation Strategies
- ❖Interior Finishes
- ❖Moisture and Infiltration Strategies

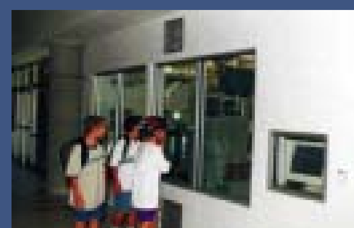
Lighting and Electrical Systems

- ❖Lighting Strategies
- ❖High-Efficacy Lamps
- ❖Compact Fluorescent Lamps
- ❖Fluorescent Lamps
- ❖Metal Halide and High-Pressure Sodium Lamps
- ❖LED Exit Lights
- ❖High-Efficiency Reflectors
- ❖Ballasts
- ❖Lumen Maintenance
- ❖Lighting Controls (including occupancy sensors)
- ❖Electrical Systems



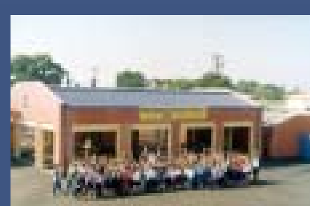
Mechanical and Ventilation Systems

- ❖Ventilation and Indoor Air Quality Strategies
- ❖Air Distribution Systems
- ❖Controls
- ❖Domestic Hot Water – solar



Renewable Energy Systems

- ❖Passive Cooling
- ❖Solar Hot Water
- ❖Solar Electric/Photovoltaics
- ❖Wind Energy

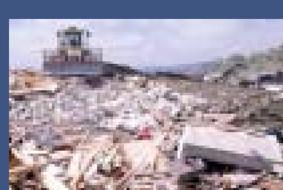


Water Conservation

- ❖Landscape Strategies
- ❖Conserving Water During Construction
- ❖Water-Conserving Fixtures
- ❖Rainwater Management
- ❖Graywater Systems

Recycling Systems and Waste Management

- ❖ Paper, Plastics, Glass and Aluminum Recycling
- ❖ Safe Disposal of Hazardous Waste
- ❖ Composting
- ❖ Construction Waste Recycling and Waste Management

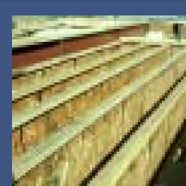


Transportation

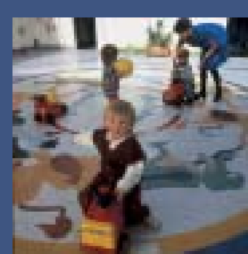
- ❖ Connecting the School to the Community
- ❖ Walkways and Bike Paths
- ❖ High-Efficiency and Low-Emission Vehicles

Resource-Efficient Building Products

The Life-Cycle Approach



- ❖Raw Material Extraction
- ❖Manufacturing
- ❖Construction
- ❖Maintenance/Use
- ❖Disposal or Reuse



How to Get These Guidelines

- DOE’s Energy Efficiency and Renewable Energy Clearinghouse (EREC)
  800-DOE-EREC
- www.energysmartschools.gov

EXISTING CONDTIONS in HAWAII'S PORTABLE CLASSROOMS

Preliminary Investigation

Stephen Meder, Arch.D.
Olivier Pennitier
UH School of Architecture

Project Description

Rebuild America grant through State of Hawaii - Energy, Resources, and Technology Division, DBEDT

UH School of Architecture

- Assess existing conditions in portable classrooms
- Develop recommendations for improved portable classroom design

Purpose of Project

Provide comfortable portable classrooms that are conducive learning environments for Hawaii's students

Project Process

Team from School of Architecture's Environmental Research and Design Lab

- Install data loggers in portable classrooms - Waianae High School
  - Collect data for:
    - Temperature
    - Humidity
    - Air movement
    - Light levels

Human Comfort

Factors that influence human comfort

- Temperature
- Humidity
- Air movement
  - – MRT

Instruments

Temperatures

- Relative Humidity
- Light

Light meters record accurate illuminance at desk-level.

Thermoflow meter records surface temperatures and net heat flow in BTU/sq.ft-hr through construction units.

Anemometers record instantaneous air flow velocity.

CO2 monitors record CO2 levels in occupied space.

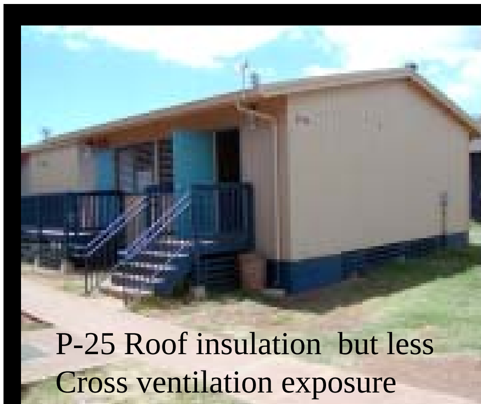
HAWAII’S CLIMATE

One of the *closest to perfect* climates in the world

Typical Conditions

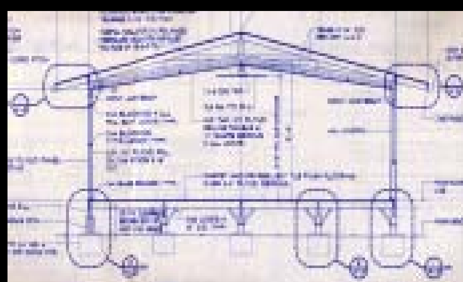
Temperature	72-82 ^{0} F
Relative Humidity	64-80%
Ave Wind speeds	10-12 mph

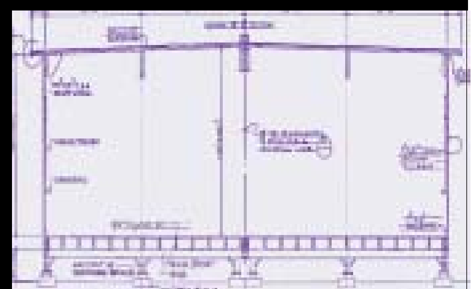
Then why are we so often
more comfortable
standing next to our buildings than in them?


P-25 Roof insulation but less Cross ventilation exposure


Roof ideal solar angle

P-26 No insulation but better Cross ventilation exposure





OCTOBER 25-28

At 7'-0" from floor:

Min. T = 71.77°F [7am]

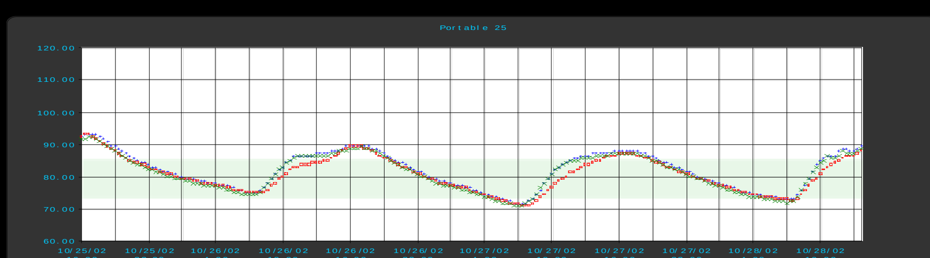
Max. T = 93.21°F [5pm]

OCUPPIED TIME:

Min. T = 74.53°F [8am]

Max. T = 89.5°F [1:40pm]

Avg. T = 84.60°F



OCTOBER 25-28

At 7’-0” from floor:

Min. T = 69.02°F [7am]

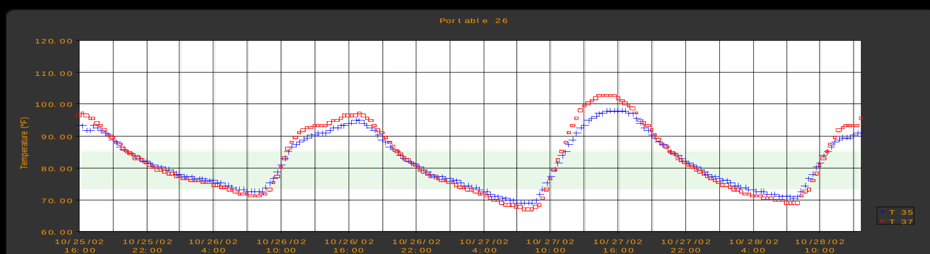
Max. T = 97.82°F [3pm]

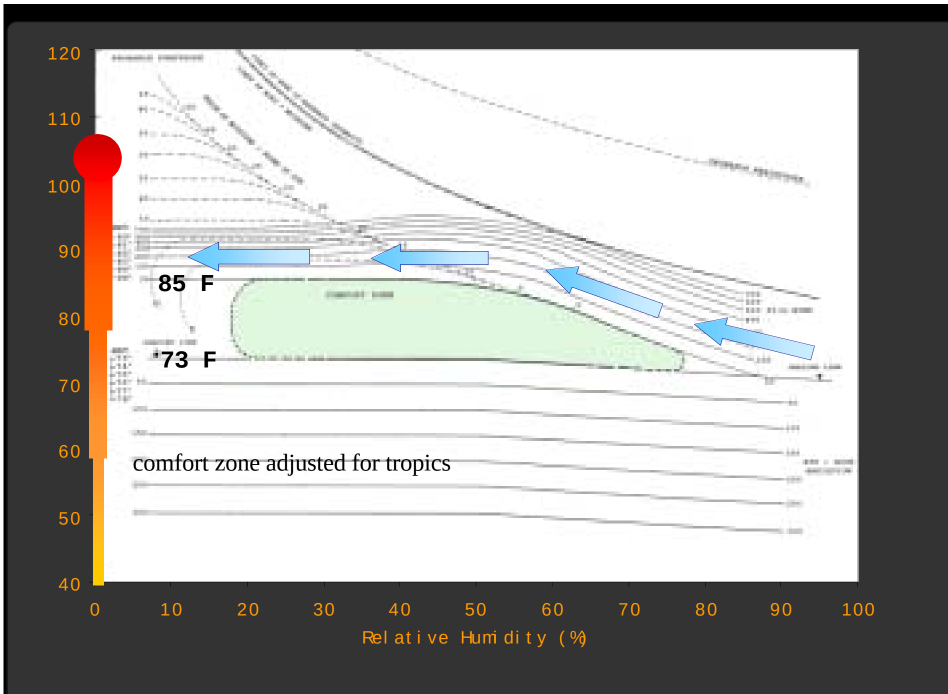
OCUPPIED TIME:

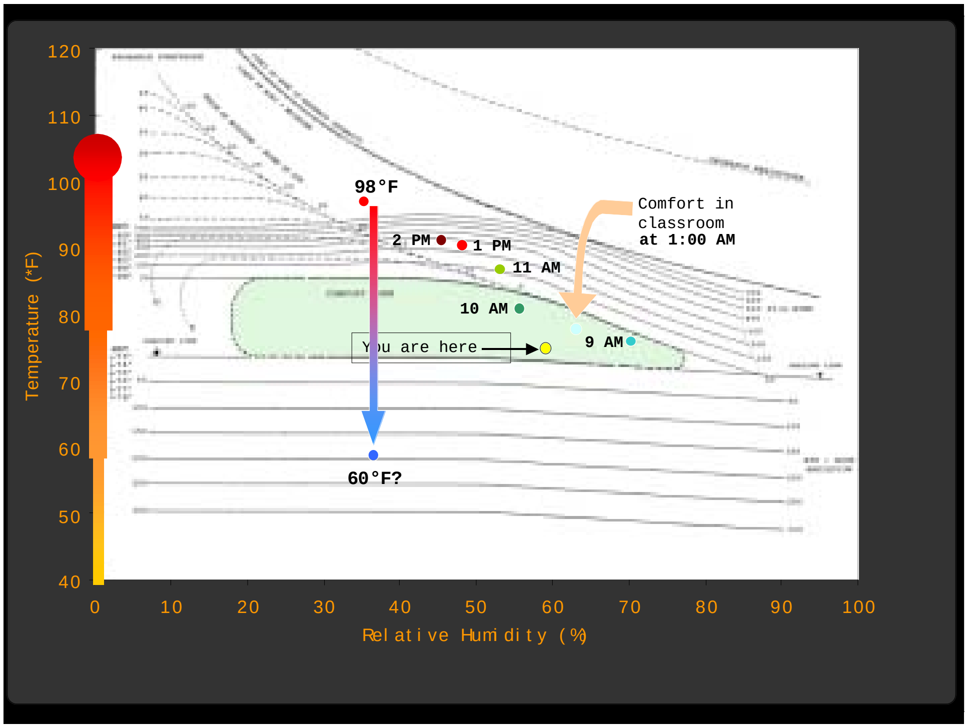
Min. T = 71.08°F [8am]

Max. T = 90.96°F [2pm]

Avg. T = 84.10°F

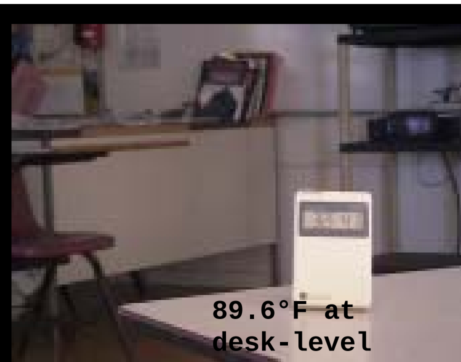






"NO LEARNING AFTER LUNCH"

Temperature at desk level and Temperatures from surrounding ceiling and wall surfaces



Bioclimatic Comfort

When the environment is outside the comfort range -

either too hot or too cold-

physical and psychological stress is the result of human's struggle for biological equilibrium

Fans in the classroom

- Who is it up to?

Convergence of Factors

- P-20 Initiative
- Politics
- Necessity
  - Performance

Numbers don't seem real-

Take the challenge

The real educational experience

Hot and Humid Climate

Passive Design Strategy

- Mitigate heat gain through building envelope
  - Roof, walls, windows
- Ventilate-
  - Evacuate internal and external heat gain from interior
  - Encourage evaporation

Hot and Humid Climate

Passive Design Strategy- con't

- Orientation
  - Grid disregards climate
- Orient to:
  - Mitigate heat gain
  - Maximize shading and ventilation
  - Create campus / community configuration

Hot and Humid Climate

Mechanically cooled units

- Reduce energy demand
- Maximize energy efficiency
- Maintain high quality indoor air /atmosphere
- Use Energy/Resource efficient materials
- Incorporate appropriate passive design strategies
- Improve quality of life within and around classrooms

Design

Architects and Engineers have never before had the design and analysis tools that we have available today

It is possible to accurately predict the performance of a building before it is built

-consider whole site

Local A& E firms can do this-

- Some in-house, some with hired consultants

Its time to do it -

We need to do it-

Attended?	Name	Title	Agency	Address			
DoE Administration							
Yes	Patricia Hamamoto	Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
No	Clayton Fujie	Asst Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
No	Al Suga	Asst Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
No	Katherine Kawaguchi	Asst Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
No	Claudia Chun	Asst Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
Yes	Rodney Moriyama	Asst Superintendant	Department of Education	P.O. Box 2360	Honolulu	HI	96804
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No	Keith Sakata	Board Member	Board of Education	P.O. Box 2360	Honolulu	HI	96804
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Yes	Nick Nichols	Facilities Planner	Department of Education	809 8th Avenue, Bldg. J, Rm. 1	Honolulu	HI	96816
Yes	Carol Ching		Department of Education	809 8th Avenue, Bldg. J, Rm. 1	Honolulu	HI	96816
Yes	Sanford Beppu		Department of Education	809 8th Avenue, Bldg. J, Rm. 1	Honolulu	HI	96816
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Yes	Gene Fong		Department of Education	1037 South Beretania Street	Honolulu	HI	96814
Yes	Robert Higuchi		Department of Education	1037 South Beretania Street	Honolulu	HI	96814
Yes	Mel Seo		Department of Education	1037 South Beretania Street	Honolulu	HI	96814
Yes	Roy Tsumoto		Department of Education	1037 South Beretania Street	Honolulu	HI	96814
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Yes	Mary Alice Evans	Acting Comptroller	Comptroller	P.O. Box 119	Honolulu	HI	96810
No	Dean Seki	Deputy Comptroller	Deputy Comptroller	P.O. Box 119	Honolulu	HI	96810
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Yes	Duane Kashiwai		DAGS Public Works	P.O. Box 119	Honolulu	HI	96810
Yes	Clarence Kubo		DAGS Public Works	P.O. Box 119	Honolulu	HI	96810
Yes	Eric Nishimoto	Branch Chief Project Management	DAGS Public Works	P.O. Box 119	Honolulu	HI	96810
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Yes	Walter Kobayashi		DAGS Public Works	P.O. Box 119	Honolulu	HI	96810
Yes	Mark Yamabe		DAGS Public Works	P.O. Box 119	Honolulu	HI	96810
Yes	Roy Tanji		DAGS Public Works	P.O. Box 119	Honolulu	HI	
Yes	Don Inouye		DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
Yes	Ray DeSmet	Mechanical Engineer	DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
Yes	Richard Yasunaga	Electrical Engineer	DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
Yes	Willie Law	Electrical Engineer	DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
Yes	Tim Lum	Mechanical Engineer	DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
Yes	T. C. Chavanachat	Electrical Engineer	DAGS Central Services	729-B Kakoi St	Honolulu	HI	96819
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Yes	Kai'iulani De Silva	Director, Education & Consumer Affairs	HECO	P.O. Box 2750	Honolulu	HI	96840-0001
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Yes	Tom Van Liew	Program Engineer, Customer Efficiency	HECO	P.O. Box 2750	Honolulu	HI	96840-0001
No	Dave Waller	Manager, Energy Services	HECO	P.O. Box 2750	Honolulu	HI	96840-0001
Yes	Sam Nichols	Program Analyst, Customer Efficiency	HECO	P.O. Box 2750	Honolulu	HI	96840-0001
Yes	Lynn Bronaugh	Program Analyst, Customer Efficiency	HECO	P.O. Box 2750	Honolulu	HI	96840-0001
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Yes	Carilyn Shon		DBEDT	P.O. Box 2359	Honolulu	HI	96804
Yes	Dean Masai		DBEDT	P.O. Box 2359	Honolulu	HI	96804
Yes	Liz Raman		DBEDT	P.O. Box 2359	Honolulu	HI	96804
USDOE							
Yes	Eileen Yoshinaka		US DOE	P.O. Box 50168	Honolulu	HI	96750
Key Legislators							
No	Sen. Norman Sakamoto		Hawaii State Senate	415 South Beretania St., Rm. 2	Honolulu	HI	96750
Yes	Sen. Brian Tanaguchi		Hawaii State Senate	415 South Beretania St., Rm. 2	Honolulu	HI	96750
No	Rep. Dwight Takamine		Hawaii House of Representatives	415 South Beretania St., Rm3(	Honolulu	HI	96750
No	Rep. Ken Ito		Hawaii House of Representatives	415 South Beretania St., Rm. 4	Honolulu	HI	96750
Speakers							
Yes	Charles Eley		Eley & Associates	142 Minna Street	San Francisco	CA	94105
Yes	Patricia Plympton		National Renewable Energy Labo	1617 Cole Blvd.	Golden	CO	80401
Yes	Steve Meder		UH School of Architecture	1918 University Ave	Honolulu	HI	96822
Yes	Kate Burke		National Association of State Ene	1414 Prince St, Ste 200	Alexandria	VA	22314
Others							
Yes	Steven Wong	Principal	Mitsunaga & Associates, Inc.	747 Amana St. #216	Honolulu	HI	96814
Yes	Paul Fukunaga	Vice President	Thermal Engineering Corp.	512 Kalihi Street	Honolulu	HI	96819
Yes	Garrett Masuda	Electrical Engineer	ECS	615 Piikoi, Ste. 207	Honolulu	HI	96814
No	Joe Ferraro	Principal	Ferraro Choi Associates	733 Bishop St, Ste 2620	Honolulu	HI	96813
Yes	Bill Brooks	Architect	Ferraro Choi Associates	733 Bishop St, Ste 2620	Honolulu	HI	96813