Indoor Environmental Quality (IEQ) Handbook

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HHF PLANNERS
places for people

US Army Corps
of Engineers
Honolulu District

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Introduction

"How can we expect our kids to do their best in places that are literally falling apart? This is America. Every child deserves a great school."

– President Barak Obama

PROJECT BACKGROUND

The connection between inadequate facility conditions and poor student performance has been established by multiple studies. The quality of students' learning environment, including "temperature, lighting, acoustics, and age of facilities -- affects dropout rates, teacher retention, test scores, and student behavior." (Dept of Interior, 2011). Investments in school facilities not only support educational goals but also strengthens positive community outcomes.

Accordingly, the focus of the Indoor Environmental Quality (IEQ) Insular ABCs' 2012-2013 assessment of school buildings, was to evaluate the condition of classroom learning facilities that have the biggest impact on student performance. Primary areas evaluated included:

- Thermal comfort,
- Indoor air quality,
- Visual comfort/lighting, and
- Acoustical performance.

Other conditions that might also affect student performance, such as the presence of pests, were noted when observed.

INTENDED AUDIENCE

The purpose of this guidebook is to empower school administrators, maintenance staff, teachers, and community members with information about how school facilities are related to IEQ. Public schools in a tropical environment encounter challenges that are unique among public schools in the continental US. This guidebook offers potential strategies to address those unique challenges.

IEQ & STUDENT HEALTH

According to the National Education Assciation:

> *All students and school employees have the right to a great public school that fosters a safe and healthy learning and work environment – and that includes indoor environmental quality (IEQ). Poor IEQ is caused by a variety of harmful factors, including: mold, poor ventilation, chemicals, extreme temperatures, asbestos, and other pollutants that negatively impact the health and achievement levels of all building occupants. Given that students and staff spend a good portion of the day and sometimes evening in a school building, this environment should be one of superior IEQ.*
>
> *According to the U.S. Environmental Protection Agency (EPA), twenty percent of the U.S. population — nearly 55 million people — spend their days in elementary and secondary schools. With many U.S. schools approaching or surpassing 50 years of age, it is not surprising that studies show that one in five of our nation's 110,000 schools reported unsatisfactory indoor air quality (IAQ), and one in four schools reported ventilation — which impacts IAQ — as unsatisfactory.*
>
> *Poor IEQ adversely affects the health of*

building occupants (particularly individuals with asthma, allergies and medically fragile students), results in increased absenteeism, and directly impacts staff performance and job satisfaction, and of course, student achievement.

Whether it is cleaning-up or retrofitting old schools or building new schools that meet LEED Standards, to provide the best learning and work environments for our students and school employees, IEQ must be addressed.

CLIMATE CHANGE IMPACTS IEQ

The primary challenge for Insular Area public schools will be moisture infiltration. More frequent or severe hurricanes can increase mold, bacteria and overall building moisture, causing indoor air quality problems. **A second challenge is user behavior.** Actions taken to reduce energy use may have the unintended effect of increasing the concentration of indoor air contaminants. As experienced in Insular public schools, air-conditioning consumes significant amounts of energy that is often wasted when cooled air leaks from a building. According to the US EPA, "Air sealing an enclosure to reduce accidental infiltration reduces [energy use], but it also lowers a building's total ventilation rate. Lower overall ventilation rates increase the concentration of some indoor contaminants and may lead to excessively high indoor humidity levels. The result is greater exposure to indoor air contaminants" (EPA, 2010).

Consequently, IEQ impacts associated with climate change are:

- Increases in indoor air contaminants due to energy conservation measures (i.e. sealing windows shut).
- Proliferation of problem organisms, exacerbated by the loss of electric power for extended periods of time.

Unlike schools in the continental US, these issues are not hypothetical. Insular Area public schools are already grappling with these issues. This guidebook acknowledges their efforts to adapt and provides additional strategies.

ORGANIZATION OF THIS GUIDE

Each chapter includes a brief discussion identifying the primary concern(s) and offers several potential mitigation strategies.

Appendix A, describes unique environmental challenges that can be used to help justify a larger maintenance budget for schools in tropical locations. These conditions are summarized in the following table.

Appendix B includes a self-evaluation checklist for each IEQ section, allowing users to identify specific issues that can become a focal point for administrators of CIP projects to address.

Appendix C lists specific IEQ issues by building, by territory. The information was gathered 2012-13; some IEQ issues may have already been remedied and are no longer relevant.

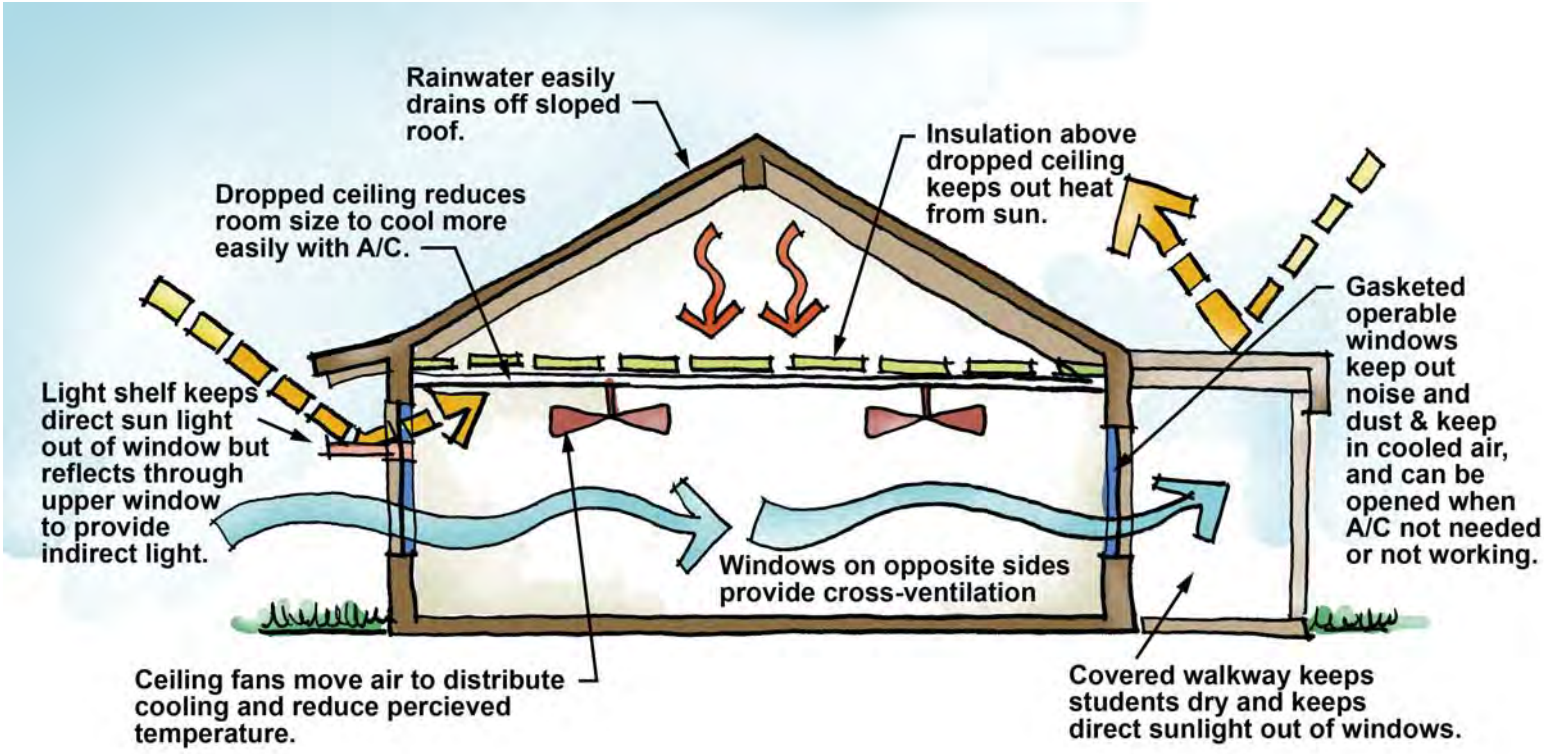
UNIQUE CHALLENGES

Schools in the tropical region are more prone to wear and tear from their coastal and tropical environment. Besides environmental conditions, remote island states also have higher shipping and fuel costs, translating to above average utility and operating expenses. Ideally, they should receive a higher percentage of Operations and Maintenance (O&M) funds than typical public schools in the continental US. However, this is rarely the case.

NEW SCHOOL DESIGN

The lessons learned from analyzing existing classroom buildings should be utilized in the planning and design of future school sites and buildings.

Figure 1: Design Considerations for Future Schools



As it is not feasible to reconstruct most school facilities, the emphasis of this guidebook is on retrofits and considerations to improve existing structures. However, design strategies for new construction and design are included at the end of each chapter. Key strategies that could have a significant impact on new building IEQ are summarized in the following section.

DESIGN CONSIDERATIONS FOR FUTURE SCHOOLS

The following bullet points summarize recommendations for creating optimal classroom spaces in new buildings:

- Buildings should have classroom spaces that are effective for air conditioning but would also be comfortable using natural ventilation.
- Designs should maximize indirect natural light (using fenestration and shading), while protecting the interior from direct sun.
- Buildings should be insulated to keep out heat and reduce noise transfer from outside and inside.
- Moisture from rain, drainage, plumbing and air conditioning should be properly controlled and directed away from the building.
- Buildings should be designed to withstand high winds and potential storms.
- Material choices should promote the extended life of building elements as well as ease of maintenance.
- Design and construction techniques that are appropriate for a tropical (hot-humid, coastal) environment may have higher initial costs, but will have a lower lifecycle facility cost by reducing ongoing operating and maintenance costs.

Table 1: Environmental Challenges Unique to Schools in the Tropics

Environmental Conditions	Description
High solar radiation	More intense levels of ultraviolet (than the continental US) results in rapid deterioration of most non-metallic roofing materials, paints, sealants, elastomeric coatings, and wood. High temperatures in building cladding and structural systems requires careful detailing of joints.
High humidity	Humid conditions promote mold and mildew growth that promote wood decay and accelerate rust. Many paints do not perform well in high humidity conditions. Vapor barriers within the building envelope require careful detailing, especially for air-conditioned buildings.
Intense rain periods and storm surges	This includes prolonged periods of rain and short, intense rainfall that causes flooding or ponding water. Structural stability, protection of openings, as well as protection from rust, and water infiltration into buildings are primary challenges.
Elevated temperatures	Prolonged high temperatures combined with high humidity can severely deteriorate building materials, especially paints, wood, and asphalt-based products.
Salt-laden air	Salt accelerates deterioration of wood, rusts metal (causing pitting in many aluminum alloys) and causes concrete spall (in inadequately protected steel rebar). Salty environments adversely affect the application of paints, sealants, elastomeric coatings, and asphalt roofing.
Pests	Insects, especially subterranean termites can rapidly destroy wooden buildings, damage electrical equipment and roofing materials.

Additional Resources

21st Century School Fund. 2010. *Research on the Impact of School Facilities on Students and Teachers: A Summary of Studies Published Since 2000.*
http://www.21csf.org/csf-home/Documents/ResearchImpactSchoolFacilitiesFeb2010.pdf

Dept of Interior, Bureau of Indian Affairs, et al. 2011. *Broken Promises, Broken Schools: Report of the No Child Left Behind School Facilities and Construction Negotiated Rulemaking Committee.*
http://www.bia.gov/WhoWeAre/AS-IA/ORM/Rulemaking/NCLBDoc/index.htm

US Dept of Energy. Tropical Island Climates Energy Design Guidelines for High Performance Schools.
www.nrel.gov/docs/fy05osti/34274.pdf

Florida Dept of Education. 2010. *Life Cycle Cost Guidelines for Materials and Building Systems for Florida's Public Educational Facilities*
http://www.fldoe.org/core/fileparse.php/5599/urlt/0074672-lccgmbsfpef.pdf

US Dept of Defense. 2006. *United Facilities Criteria (UFC) Tropical Engineering, Change 2.*
www.wbdg.org/ccb/DOD/UFC/ufc_3_440_05n.pdf

Collaborative for High Performance Schools. *Best Practices Manual IV: Maintenance & Operations. 2004.*
http://www.chps.net/content/288/CHPS_IV_2004.pdf

National Education Assoc. *Indoor Environmental Quality*
http://neahealthyfutures.org/get-informed/school-safety/environmental-health/indoor-environmental-quality/

EPA. 2010. *Indoor Environmental Quality and Climate Change.*
http://www.epa.gov/sites/production/files/2014-08/documents/climate_change_brennan.pdf

WBDG Sustainable Committee. Updated 2015. *Enhance Indoor Environmental Quality (IEQ).*
http://wbdg.org/design/ieq.php

Thermal Comfort

Summary

One of the primary challenges for schools in tropical climates is managing high thermal temperatures and humidity. This chapter offers short and long-term strategies to manage heat gain, including major considerations *before* adding air-conditioning.

Hawai'i DOE is featured as a case study investigating costs and alternative heat abatement strategies.

Heat Radiating Through Roof and Walls

Problem

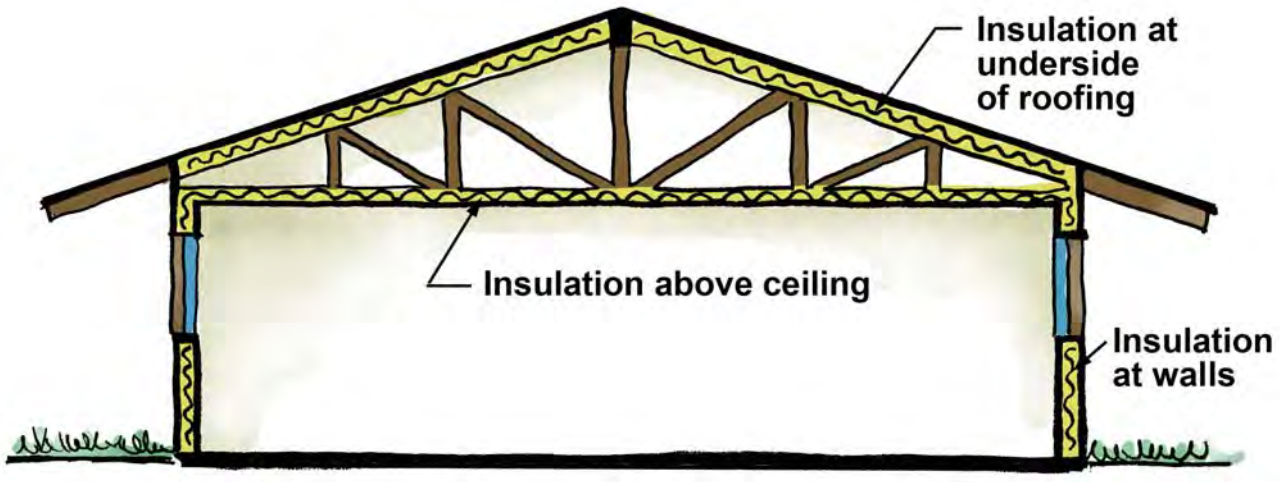
Direct solar heat gain on a building's roofs and walls raises interior temperature. Classrooms that are too hot, create poor student learning environments.

Potential Solutions

Install Insulation

To reduce this effect, install roof and/or wall insulation. Buildings can be retrofitted with insulation on the underside of the roof and in the wall cavity. Insulation can also be installed above the ceiling, keeping heat in the attic area, where it can be removed with roof/attic vents.

Figure 2: Building Insulation within the Exterior Envelope



Pros and Cons of 3 types of insulation

Batt Insulation

Pros

- Low material cost.
- Widespread availability.
- Easy installation in existing or new buildings.

Cons

- Performance dramatically diminishes if not installed properly.
- Low R-value vs. other insulation types.
- Loses R-value when compressed or wet.
- Can support mold growth (traps moisture).
- Requires ventilation; not ideal for unvented flat or low-slope roofs.

Best for

- Sloped roofs with dropped ceilings.

Batt insulation in attic

Roof Insulation Boards:

Pros

- High R-value.
- Can be used to add slope to a flat roof.
- Can help protect roof structure.

Cons

- Proper installation is critical to prevent moisture leakage.

Best for

- Flat or low-slope roofs, especially where drainage needs improvement.

Foam board insulation on roof

Radiant barrier:

Pros

- Low cost
- Can be combined with other insulation.

Cons

- Proper installation is critical.
- Can trap moisture in roof sheathing and reduce life of roofing.
- Reduces radiant heat but not heat conduction.
- Effectiveness reduced if dusty.
- Difficult to install during retrofit unless the roof is being replaced.

Best for

- New roofs or roof replacement on a sloped roof.

Radiant barrier insulation draped between trusses

Heat Reflecting from Adjacent Pavements

Problem

By absorbing heat from the sun's rays, paved areas can substantially increase the temperature of adjacent buildings.

Strategies

Minimize outside adjacent paved areas
Installing vegetation, water features, or light-colored surfaces will help to keep the surrounding areas cooler.

Install exterior shade trees
Shading the building and adjacent areas, particularly in the early afternoon hours, will help keep the building cooler. This can be done with landscaping, or with other buildings or structures.

Trees should be placed a minimum distance of ½ times mature canopy diameter from buildings. Selection of tree species should consider: local climate conditions (i.e. ability of tree to resist collapse in hurricane force winds), minimize foundation disturbance caused by roots, and minimize conflicts between the mature tree canopy and adjacent building walls and roofs.

Direct Sunlight into Classrooms

Problem

Direct sun rays through wall openings can substantially increase the interior temperature (as well as create glare).

Graphic source: 4

Strategies

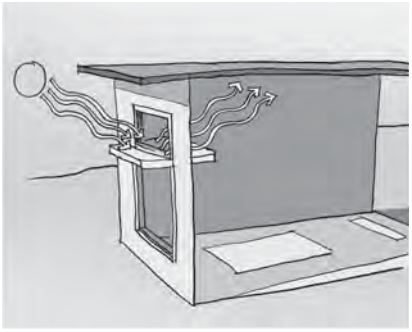
Install interior window shades
Window shades help block direct sunlight and allows users to adjust the amount of sunlight entering a room. Shades can also be used to provide privacy or reduce exterior visual distractions when needed.

In the territories, occupants sometimes cover windows with fabric to keep out direct sunlight and add space for exhibiting student work. But this has the effect of blocking the natural flow of air and makes classrooms feel dark. Studies have shown that students perform better on standardized tests in classrooms with access to natural light.

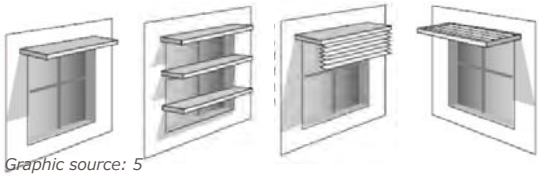
Install exterior shade devices over windows
Exterior shading devices can help block direct sunlight and allow diffuse indirect light. The west and south sides of a building (north side in American Samoa) have the highest solar exposure.

On the south side, shade windows with a standard horizontal overhang. Alternatively, light shelves above the windows, awnings, and exterior shade screens can be used (see chapter on Light Levels).

Figure 3: South-facing Window Shading



A light shelf reflects indirect light into a classroom, while keeping the heat outside.



Graphic source: 5

Variations of a standard horizontal overhang that provide shade and indirect daylight.

Figure 4: East & West-facing Window Shading

Vertical louvers or fins block direct sunlight in the morning and afternoon.

Limited Airflow in Room

Problem

Airflow improves interior comfort by making people feel cooler than it actually is. When there is no air movement, classrooms can be miserable places to learn. Inadequate airflow can be due to:

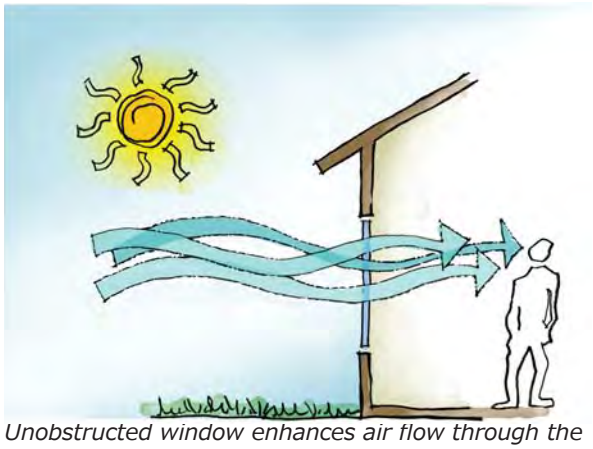
- Outside obstructions, such as adjacent buildings, walls, fences or vegetation;
- Windows with inadequate openable area;
- Not enough windows;
- Openings on only one side of the room;
- Not enough fans or broken fans.

Strategy

Remove airflow obstructions

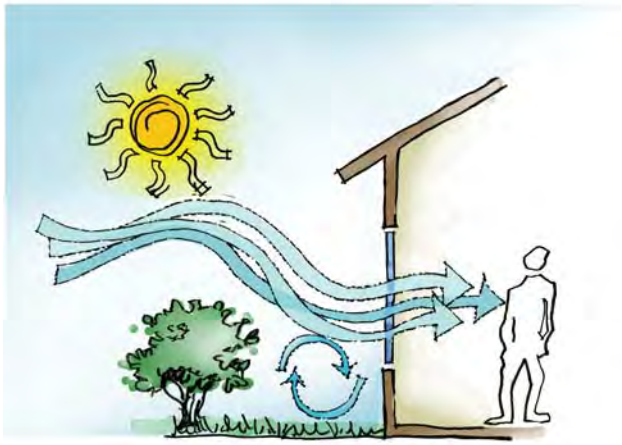
Removing exterior obstructions to airflow can help increase natural ventilation. Look for solid walls, berms, and other obstructions that may be blocking classroom windows.

Figure 5: Unobstructed Window



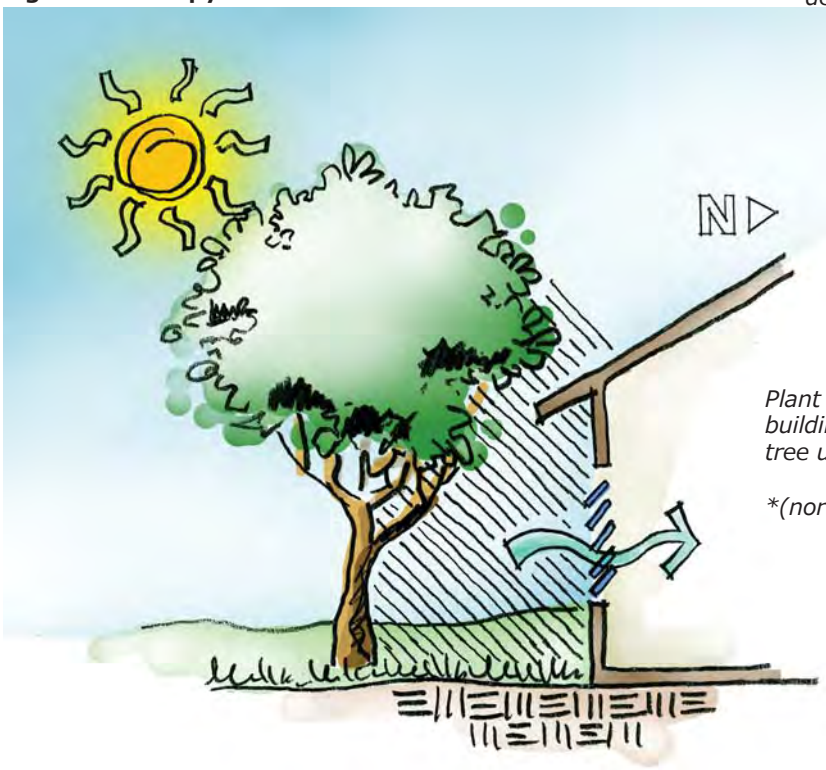
Unobstructed window enhances air flow through the classroom.

Figure 6: Low-Shrubs and Air Flow



Low shrubs planted outside (up to 20 feet away from the building) can also enhance air flow by creating downward deflections of air movement.

Figure 7: Canopy Trees and Air Flow



Plant tall canopy trees on the south side of buildings to shade roofs and walls. Keeping the tree understory clear, promotes ventilation.*

**(north side for American Samoa)*

Add windows for cross-ventilation
Windows on both sides of the room will greatly increase air movement. However, more windows means less display space. Wheel-mounted whiteboards or tiered sliding wall-mounted display boards might provide a creative alternative for pinup space.

Increase window size
Adding more or larger windows will improve natural ventilation. However, before modifying a structural wall, consult a structural engineer.

Increase window openable area
Window types greatly affects how much of the window can be opened. Casement windows have about 90% openable area, whereas sliding windows are only 45%-50% openable.

Reduce leakage of cool air
Some naturally ventilated buildings have already been converted into air-conditioned spaces. As a temporary solution, some classrooms installed plexiglass over louvered windows to prevent leakage of air-conditioned air.

However, if the air-conditioning breaks down or is turned off, students will not have access to fresh air or natural ventilation. Ideally, windows in air-conditioned classroom should be gasketed to reduce air leaks, but also be openable.

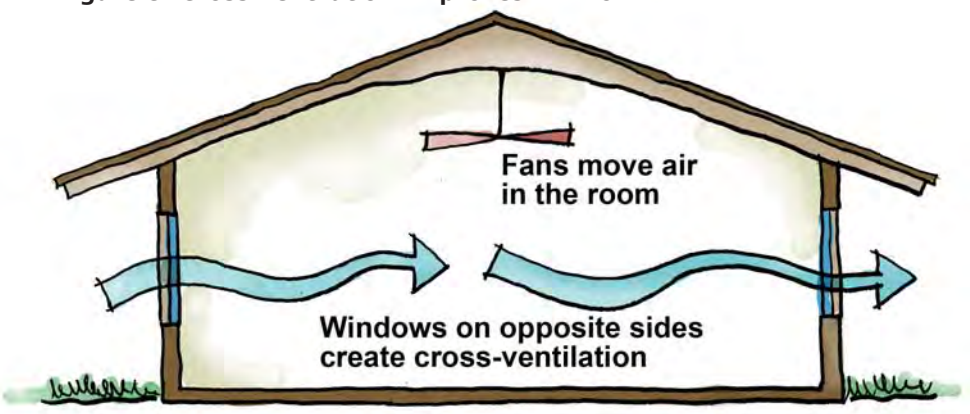
Install fans
Fans should be adequately sized and located to ensure adequate coverage for the entire classroom. Fans also consume less energy than air-conditioning and have lower first-costs, operating, and lifecycle costs.

Plexiglass covering windows help retain cooled air but also eliminate the possibility of natural ventilation.

Graphic source: 6

Openable area as a percentage of window area

Figure 8: Cross Ventilation Improves Air Flow



Fans make you feel cooler

While air movement does not lower the actual temperature in a space, the perceived cooling effect of wind blowing across a person's skin, can make them feel up to 10°F (5.6°C) cooler.

Naturally Ventilation or Air-Conditioning?
For most existing, naturally ventilated classrooms, adding air-conditioning should be a last resort, after considering alternative shading and cooling strategies. Air-conditioning is associated with high initial installation costs and ongoing operational costs. According to the US Department of Energy, air-conditioning systems in tropical island climates are typically responsible for 55%-65% of the energy consumed in schools.

A mechanical engineer and architect should be consulted to design an appropriate and energy efficient air-conditioning system and exterior building envelope enclosure.

Retrofitting an existing classroom with air-conditioning typically includes:

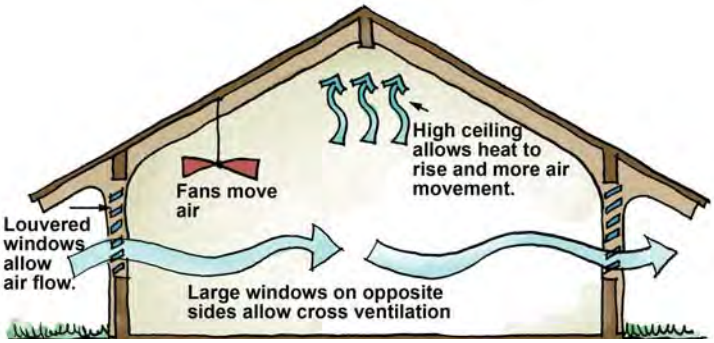
- Installing an acoustic ceiling (this reduces the volume of air that must be cooled) and roof insulation,
- Providing air-tight windows and doors,
- Retrofitting the exterior envelope with a vapor barrier to reduce condensation and mold on the building interior,

Remote controlled thermostats may prevent users from setting the indoor temperature below the ambient dew point. When water vapor condenses, it can cause mold to accumulate inside wall cavities and on the surface of wall coverings.

This may require long-term capital investments that are beyond typical repair and maintenance budgets.

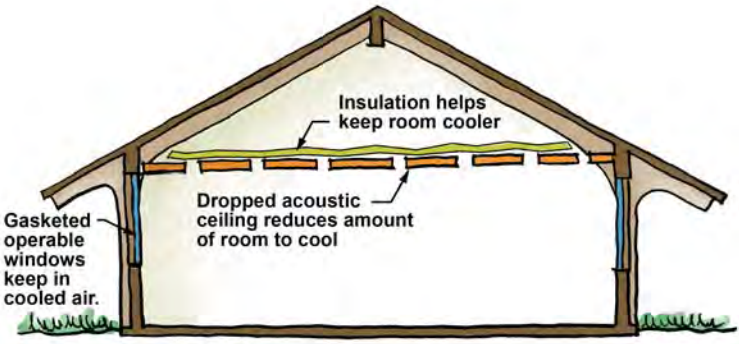
Another challenge of air-conditioned classrooms in hot-humid climates, is that they should also be designed for natural ventilation in the case of a non-working AC system, i.e. a power outage caused by a typhoon.

Figure 9: Naturally Ventilated Rooms



Classrooms designed for natural ventilation have high ceilings and many large window openings.

Figure 10: Air-Conditioned Rooms



Classrooms designed for air conditioning have suspended ceilings and gasketed windows.

Hidden Costs When Converting to Air-Conditioning:

- Initial installation costs (may include): retrofits for air-tight windows and doors, roofing insulation, vapor barriers in wall cavities, and electrical upgrades.
- Maintenance costs: may be higher for areas that do not have a sufficient number of skilled tradesmen or for Insular areas that must pay a premium to import replacement parts. Warranty coverage may lapse without routine maintenance and servicing.
- Operating costs: To reduce the accumulation of mold, some schools report needing to operate the air-conditioning all day, 24/7, even during summer months when buildings are vacant. Projected increases in energy costs should also be considered.

Building Orientation

Problem

When buildings are constructed without considering solar orientation, it can expose classrooms to hot afternoon sun, create an uncomfortably hot classroom environment, and require air-conditioning and increased electrical operating costs.

Strategies

Align Buildings Along East-West Axis

Most buildings typically have roof overhangs that can help shade window openings along the north and south sides.

In the US territories, north-facing windows typically have minimal solar exposure. South-facing windows can be completely shaded using a large overhang or a covered patio in front of the window – see Figure 11, next page.

However, on the east and west sides, horizontal building overhangs provide minimal solar shading for windows. This is due to the low angle of the sun as it rises in the east and sets in the west. See Figure 4 for an example of vertical fins that can be used to shade windows on east and west-facing windows.

Case Study: Hawai`i DOE

The Hawai'i State Department of Education (HDOE) website states, "As the state's cooling tradewinds continue to decline and the heat index continues to rise due to climate change, **HDOE is challenged by the need to install air conditioning at all public schools."**

HDOE's heat abatement strategy includes several options (note: these options are not suitable for all schools):

- Solar-Powered Fan/Ventilators
- Photovoltaic Air-Conditioning
- High Efficiency Skylights
- Added Insulation
- Ceiling Fans
- Roof Coating
- School schedule modification
- Air-Conditioning

Due to cost constraints, air-conditioning is not targeted for all schools. HDOE estimates the following installation costs:

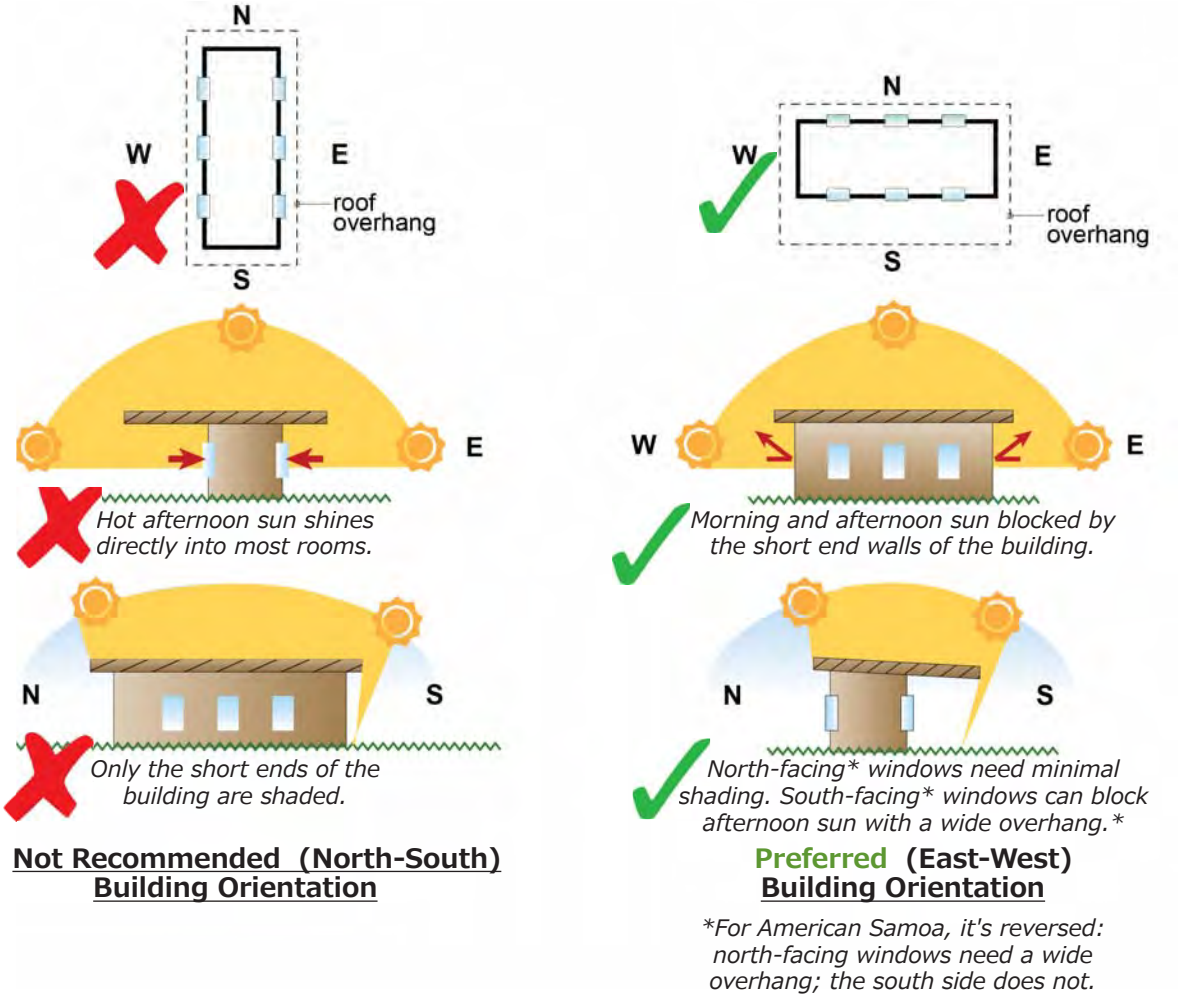
- $110,000 per typical classroom
- $5 million per elementary school
- $10 million per middle school
- $15 million per high school
- $1.7 billion for all HDOE schools

These figures do not include ongoing operating costs (i.e. energy) or repair and maintenance costs. HDOE estimates installing air-conditioning will double a school's current energy bill. In FY2017, electricity is estimated to cost $47.6M.

The primary obstacles for air-conditioning HDOE schools are the initial installation cost, upgrading electrical infrastructure, and other building upgrades that support air-conditioning. HDOE has prioritized the hottest schools, paired with suitable heat abatement measures.

For more information, see Additional Resources.

Figure 11: Building Orientation and Solar Exposure



Additional Resources

US Dept. of Energy. *Tropical Island Climates Energy Design Guidelines for High Performance Schools.*
www.nrel.gov/docs/fy05osti/34274.pdf

State of Hawai'i Department of Education. 2015. *Heat Abatement Program*
http://www.hawaiipublicschools.org/ConnectWithUs/Organization/SchoolFacilities/Pages/ACCost.aspx

US Dept. of Energy and Lawrence Berkeley National Laboratory. 2013. *Tips for Daylighting with Windows.*
https://windows.lbl.gov/daylighting/designguide/LBNL_Tips_for_Daylighting.pdf

Thermal Comfort Design Strategies For New Classrooms

- Site new buildings with the long axis aligned east-west axis, so that only the short end walls are exposed to low-angled morning and afternoon sun.
- Site buildings to maximize natural cross ventilation.
- Provide windows on at least 2 sides of room.
- Provide exterior shading (trees).
- Use operable windows with ample openable area and low-e glazing.
- The type of shading device depends on window orientation. Provide large eave overhangs on south-facing windows (north-facing in American Samoa). Use vertical fins to shade east and west-facing openings.
- Install insulation in building roof and walls.
- Use light fixtures that don't produce heat.
- Install ceiling fans even in air conditioned rooms.
- Install interior window shades.
- Use light-colored exterior and interior finishes.

Light Levels

Summary

Proper daylight levels improve student performance, focus, attendance, and general health, while also reducing electricity operating costs. Access to views and natural lighting are extremely important, especially for Americans who typically spend 90% of their time indoors, mostly exposed to fluorescent light. Insufficient daylight disrupts the body's natural circadian rhythm and has been linked to obesity, diabetes, and depression.

In contrast, classrooms illumined by daylight report higher test scores and faster learning students than settings with little daylight.

Besides providing more daylight, adding differential lighting controls and interior shading devices gives teaches greater flexibility, allowing classrooms to support a wider range of activities.

Non-Functioning Lights

Problem

Not all lights are functional. Some are simply missing lens covers or working bulbs/lamping. However, some light fixtures are broken and need to be replaced, or the wiring is not properly connected.

Strategy

Routine Maintenance

A preventive maintenance schedule can establish set intervals for specific tasks. For example, once a year, light fixtures can be inspected to replace lamping (light bulbs), lense covers, repair faulty wiring, and recalibrate replacement schedules.

Corroded light fixture; missing light cover.

Above: *Users wrap fabric around lighting because the room feels too bright and hot. Instead, differential light controls would allow users to turn off or dim a portion of the lights.*

Light Fixtures Inadequate

Problem

Some classrooms do not have enough fixtures or the fixture output is too low.

Strategy

Add or Replace Fixtures

Light levels should meet minimum requirements for classrooms. Install new or additional lighting where needed.

Differential Lighting Control

Problem

As the amount of daylight and type of learning activity change throughout the day, portions of the classroom can be overlit or too dim for the scheduled activity.

Strategies

Differential Controls and Dimmable Light Fixtures

Install light fixtures with differential controls and/or dimmer switches. Differential light controls allow portions of the classroom to turn lights on and off (or dim light levels). This gives users more control over the level of brightness and can potentially reduce electricity use.

Enhancing the ability of users to adjust lighting levels throughout the day, also supports a wider range of teaching styles and learning activities within the same space (i.e. computer use, presentations to a darkened room, or desk writing).

Photos: *Classrooms have different reasons for blocking windows.* ***Left:*** *Windows blocked to reduce glare and reduce air-conditioned air leakage.* ***Right:*** *Windows blocked to reduce glare but also blocks natural ventilation.* ***Far Right:*** *As a temporary solution, clear plastic is used to reduce air-conditioned air leakage while allowing flexibility for natural daylighting.*

Natural Lighting Not Optimized

Problem

Student performance improves in classrooms with daylight (versus 100% artificial light). Natural illumination also has health benefits. However, in this assessment, many of the classrooms visited had sealed their windows shut. Storm shutters were often permanently closed and even wood and metal louvers, which are easily opened, were kept shut.

Windows were closed for various reasons: to block the sun's heat, reduce air-conditioned air leakage, reduce outside distractions during class, and enhance security. These actions prevent natural daylight from entering the room and also reduce or eliminate opportunities for natural ventilation.

Strategies

Make louvers operable or replace window
All wood or metal louvers should be in working condition or replaced with a window that can be opened to admit daylight.

Install operable clear panels
If using air-conditioning in a room with wood or metal louvers, an openable or removable clear panel of some type can be installed on the inside of the louvers to retain cooled air so that the louvers can remain open (to allow natural light) during class.

Enlarge windows
If windows are too small to provide ample natural light, or are non- existent, new windows of a size that can provide adequate natural light should be installed.

Install Interior shades
If sunlight is directly entering the room during part of the day, adjustable interior shades are recommended (versus fixed window coverings) to allow occupants to adjust the amount of light and visibility available through the window. Fabric and paper blocks natural light at all times and limits ventilation, whereas shades can be easily opened as the sun moves (or the distraction is no longer present).

Graphic source: 7

Window shades allow users greater control over the amount of daylight in the learning environment.

Glare

Problem

Glare is difficulty seeing in the presence of bright light such as direct or reflected sunlight or artificial light. It often occurs when direct sunlight enters through a window and reflects off of horizontal surfaces such as classroom desks.

Strategies

Window Tint

One method to reduce glare for existing windows, is to install window tint. Considerations for selecting the right window tint are: the amount of heat transmitted thought the glazing (Solar Heat Gain Coefficient) and how dark the tint appears from the inside (Visible Light Transmission). See Figure 12 at right.

Exterior Shades

Glare can also be reduced by installing exterior shades such as a light shelf, or interior window shades.

Heat reflective window tints can reduce glare and heat gain for existing windows.

Graphic source: 8

Window Shades

Interior window shades are helpful in blocking direct sunlight and can be easily opened from inside, allowing teachers to modulate the amount of light entering the classroom throughout the day. Interior treatments can also be used to provide privacy or reduce exterior distractions when needed.

Graphic source: 9

Bottom-up shades allow natural light while blocking undesirable views at the bottom.

Figure 12: Energy Efficient Window Glazing

Window type	Typical values (see below for details) SHGC*	VLT**	UV%***	Cost
BEST — Low-e² windows	.36	.70	43%	+$4.00/s.f.
Make sure to get the "tropical," "sunbelt," or "low-e squared" type of low-e window with a SHGC of less than 0.40.				
Double-paned				
BETTER — Green/blue tinted	.69	.83	42%	+.50¢/s.f.
GOOD — Gray or bronze tinted	.69	.61	35%	+.50¢/s.f.
POOR — Clear	.86	.90	71%	–

Look for the SHGC on the window's NFRC label.

*SHGC = Solar Heat Gain Coefficient measures the fraction of solar heat admitted through a window; the lower the SHGC, the less heat transmitted.

**VLT = Visible Light Transmission indicates the fraction of visible light admitted through a window; the higher the VLT, the more light that passes through.

***UV = Ultraviolet light. Lowering the UV light coming in through a window can help prevent sun damage to people, furnishings, carpeting, and drapes.

Graphic source: 10

Figure 13: Visible Light Transmission (VLT)

0.9	Standard Double Glazing
0.5–0.9	Internal Venetian Blinds — Drawn
0.4–0.8	Internal Curtains — Drawn
0.4–0.8	Internal Roller Blinds — Drawn
0.7	Heat-Absorbing Glass
0.6	Tree Providing Light Shade
0.5	Internal Blind — Reflective Backing
0.4	Solar Control Glass
0.2	External Blinds — Drawn
0.2	External Shutters — Closed

Range of Visible Light Transmission (VLT) values is greatly affected by the type of window treatment used

Graphic source: 10

Figure 14: Exterior Window Shading Devices

Exterior

- Provide excellent solar heat gain control.
- Provides added layer of security.
- Provides storm protection.

Graphic source: 11

Graphic source: 11

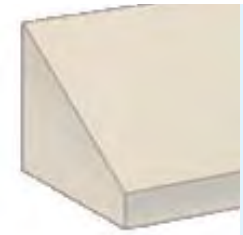
Roller Shutter

- Economical
- Helps reduce solar gain through windows.
- Can be installed as fixed panels face-mounted, similar to an insect screen but reduces solar heat gain.

Graphic source: 11

Graphic source: 11

Exterior Solar Screen



- Provides good solar heat gain and glare control while maintaining view.
- Directs rain away from windows
- Maintains window egress

Graphic source: 11

Graphic source: 11

Fixed Awning

Figure 15: Interior Window Shading Devices

Interior

- Economical
- Privacy or aesthetics are driving concerns
- Room requires complete darkness
- Higher-performance window treatments cannot be justified.

Graphic source: 11

Graphic source: 11

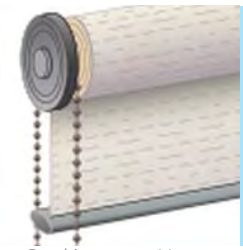
Curtains and Drapes

- Recommended in climates with moderate to significant cooling requirements
- High glare situations
- Helps reduce solar gain through windows

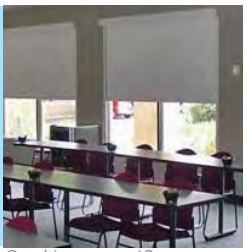
Graphic source: 11

Graphic source: 12

Interior Solar Screen



- High glare situations
- Helps reduce solar gain through windows
- Can specify degree of light transmission of shade material



Graphic source: 11

Graphic source: 13

Interior Roller Shade

Dark Interior Surfaces

Problem

Dark wall and ceiling surfaces do not reflect light well and cause a room to be darker.

Even with three windows and an open door, this room feels dark. Light colors are recommended.

Strategy

Avoid Dark Interior Colors

Lighter colors reflect more light in the room, and will reduce the need for mechanical lighting. Ensure that the classroom walls and ceilings are painted a light color.

Add Skylights

For interior spaces that do not have adequate access to natural light or ventilation, adding skylights or clerestory windows can provide supplemental natural light and possibly ventilation. Solar access tubes in particular, include a reflective tube that can illumine hard-to-reach spaces.

Roof penetrations must be carefully designed and consider solar heat gain, potential for leaks and hurricane resistance.

Graphic source: 14

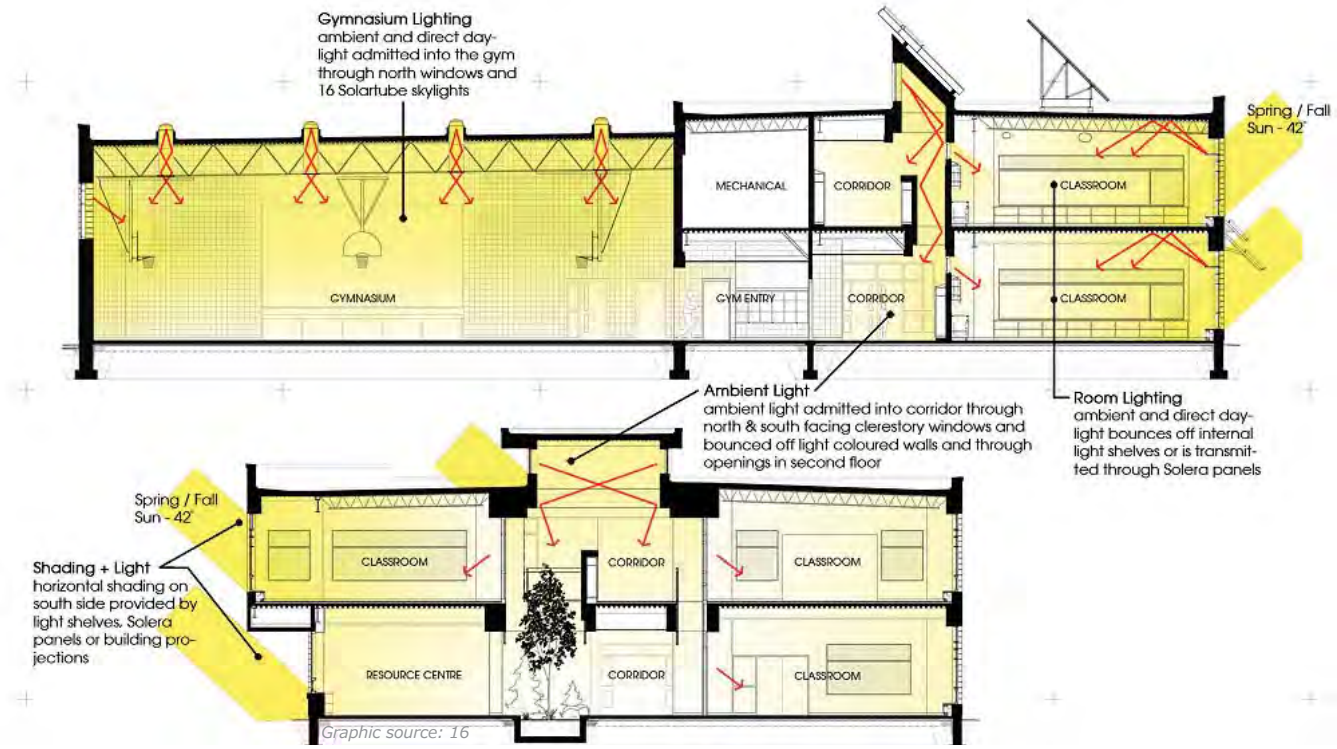
Solar light tubes are able to draw-in sunlight into hard to reach places

Design Strategies to Optimize Daylighting and Energy Efficiency

- Install efficient lighting with differential controls.
- Select light fixtures that are energy efficient, have a long life, require minimal maintenance, and are the best selection for the space.
- Maximize use of natural lighting through windows, clerestories.
- Provide ample wall space for display so that windows won't be covered to create display areas.
- Use windows with low-e glazing and no opaque materials (such as wood or metal louvers).
- Provide interior window shades.
- Provide exterior window shades such as light shelves.
- Paint interior walls and ceilings a light color.

Graphic source: 15

As part of its strategy to reduce air-conditioning, the Hawaii state Dept. of Education is installing light tubes, solar vent fans, and white membrane roofs on classroom roofs. Tall canopy trees also help shade classroom buildings.



Building sections illustrate a variety of ways to extend (mostly indirect) daylight into interior spaces.

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Air Quality

Summary

Air quality affects the comfort and health of building occupants, and can affect attendance, concentration, and student performance. Inadequate indoor air quality can result in health concerns such as fatigue, allergic reactions, coughing, eye irritation, headaches, nausea, asthma episodes, and even life-threatening conditions. Maintaining good air quality requires a team effort of the facility management, maintenance staff, and building users.

Mold

Problem

Moisture within the building stimulates the growth of molds. Excess moisture may be due to roof or plumbing leaks, poor site drainage directing water towards the building, humidity, and condensation problems. Moisture also encourages the presence of pests.

Strategies

Remove

Remove all mold with a mildewcide or bleach.

Replace any moldy ceiling panels.

Replace wall finish if mold cannot be removed.

Determine source of moisture and eliminate it.

Mold on exposed roof framing

Poor site drainage stimulates mold growth within classrooms

Why is Mold Bad?

All molds have the potential to cause health effects, including irritation of the eyes, skin, nose, throat and lungs. Molds can also trigger allergic reactions or asthma attacks, and some produce potent toxins. Molds can grow on almost any substance, as long as oxygen and moisture are present.

Ventilate
Remove paper or other materials preventing use of operable windows

Ventilate rooms and allow in natural light during times when rooms are not in use (i.e. summer vacations)

Use a dehumidifier in the room

Prevent
Check regularly for leaks or other sources of moisture.

Establish AC maintenance program to keep air intakes and filters clean. Check and clean ceiling fans.

Additional Resources

Environmental Protection Agency (EPA) Sensible Steps to Healthier School Environments (2012).
http://yosemite.epa.gov/R10/ecocomm.nsf/childrenshealth/sensible-steps-webinars

Department of Education's Green Ribbon Schools http://www2.ed.gov/programs/green-ribbon-schools/index.html
EPA's School Siting Guidelines http://www.epa.gov/schools/guidelinestools/siting/

A Brief Guide to Mold, Moisture, your Home
http://www.epa.gov/mold/moldguide.html#biocides

Steps to Control Moisture

- Keep indoor humidity levels below 60%, ideally between 30% and 50%.
- Dry wet spots within 48 hours.
- Fix plumbing and roof leaks.
- Look for condensation and wet spots.
- Address sources of moisture immediately.
- Remove mold and restore surfaces to clean/dry condition.

Left: *Replace rusted AC grill.* ***Middle:*** *Clean dusty ceiling fans.* ***Right:*** *Replace ceiling panels that have mold* ***Above:*** *Remove mold on wall or replace wall board*

Left: *Bird nest and debris in air vent.* ***Middle:*** *Mold growing near window AC.* ***Right:*** *Trash area next to a classroom window*

Odor

Problem

Bad odor affects the comfort of building occupants, and can affect attendance, concentration, and student performance.

Strategies

Determine source of odors and eliminate them when possible. Odors may be due to nearby trash bins, areas where water stagnates, restrooms, vents from other rooms or buildings, etc.

Install operable windows that can be closed if odors/ dust are only a periodic occurrence

Maintain AC system. AC systems need to be maintained and kept clean and operable, with clean unobstructed air intakes. Unused systems should be removed and vents closed up.

Ensure paints and other building materials do not have off-gassing that create fumes or bad smells.

Clutter or Trash

Problem

Garbage gives off odors, noxious gases, and attracts pests. Storing trash next to buildings creates an unhealthy learning environment. Clutter inside rooms also attracts pests and retains dirt and dust. Classroom materials should be kept organized and stored away.

Strategy

Keep areas around classrooms clean and free of trash.

Outside Dust

Problem

If the areas outside of windows are dusty, it is likely dust will get into the rooms and any AC system.

Strategy

Where possible, landscape and/or hardscape areas by classrooms to reduce dust. Plants should be kept at least three feet away from buildings. If plants are too close to buildings they can trap moisture, attract insects, and damage buildings.

Clockwise from Left: *No landscaping creates dusty yard outside classroom windows.* ***Right:*** *Plants and dust near air vent.* ***Bottom:*** *Window screen collects dirt and mold; needs routine cleaning*

Vehicle Exhaust Fumes

Problem

Vehicle exhaust and dust from vehicles driving ngatively impacts air quality. At many schools, there is limited area for parking and site circulation.

Strategy

Every effort should be made to relocate parking areas and roads that are adjacent to classroom buildings. Also ensure that idling busses and cars waiting to pick up students are not expelling exhaust fumes into school buildings or waiting areas.

Carbon Monoxide (CO)

Exposure to concentrated levels of CO may result in a variety of flu-like symptoms such as dizziness, fatigue, headaches, disorientation and nausea.

High levels of exposure can result in loss of consciousness and death.

Left: *Overgrown landscaping can damage structure, trap moisture, and allow pests to enter.* ***Right:*** *Parking too close to classroom windows and AC.*

Design Strategies to Optimize Air Quality

- Design classrooms for natural ventilation.
- Install ceiling fans in all classrooms.
- Maximize natural light into rooms using large, shaded windows and clerestories.
- Drain condensation from AC units away from building.
- Direct roof and ground runoff away from building and foundations.
- Locate classroom buildings away from roads and parking areas.
- Ensure areas around classroom buildings have landscape or hardscape.
- Specify low VOC paint and interior finishes

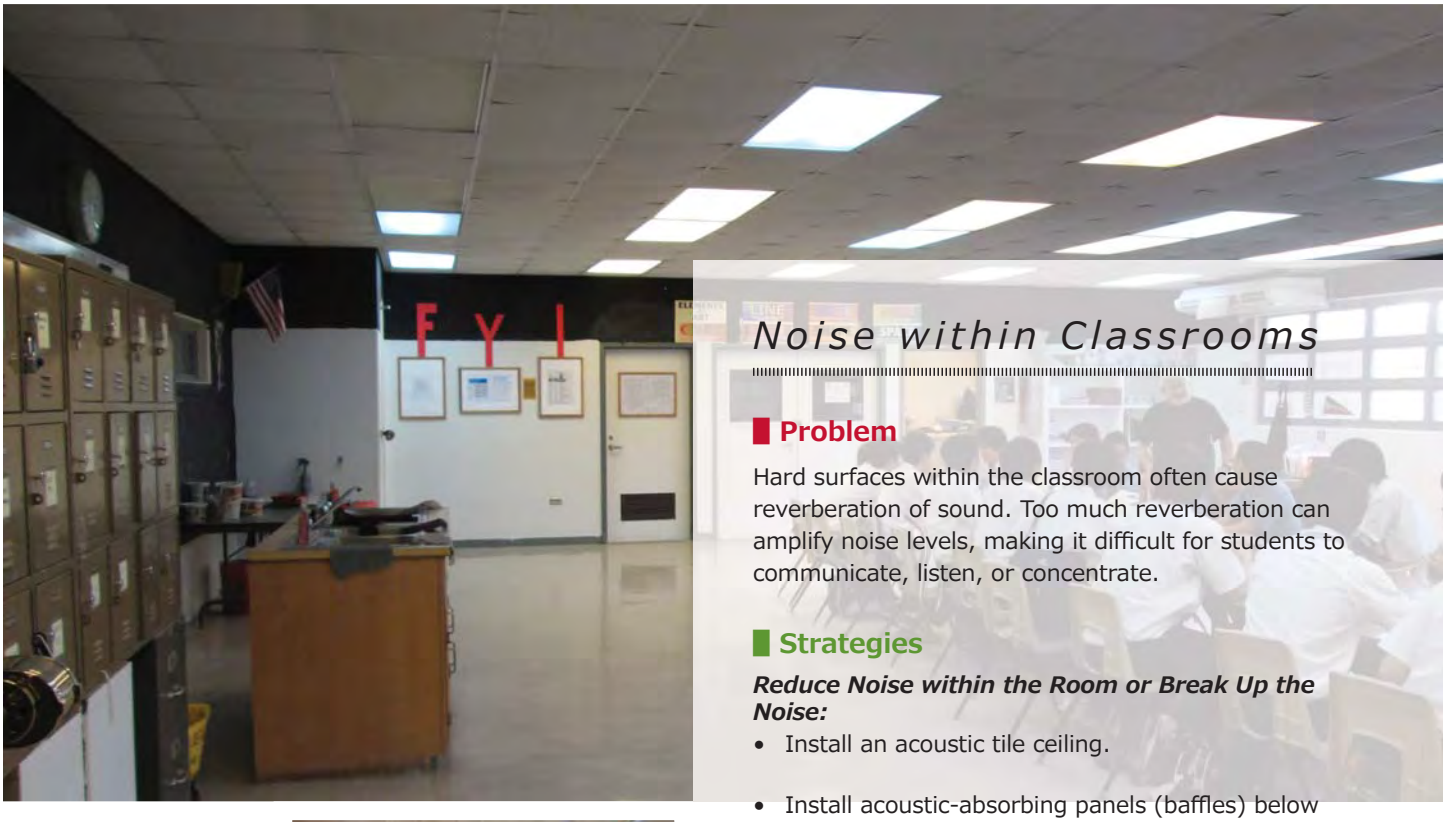
Road too close to classroom

Acoustics

Summary

Background noise and the amount of sound reverberation in the classroom interfere with learning and concentration.

Facility interventions to control unwanted sound include adding wall insulation, acoustic ceilings, suspending ceiling baffles, or gasketed windows and doors. Future classrooms should be sited away from sources of noise pollution.



Above: *Acoustic tile ceilings help to reduce noise in the classroom.*

Right: *Ceiling baffles help reduce sound transmission in high ceiling, open plan rooms.*

Graphic source: 17

Noise within Classrooms

Problem

Hard surfaces within the classroom often cause reverberation of sound. Too much reverberation can amplify noise levels, making it difficult for students to communicate, listen, or concentrate.

Strategies

Reduce Noise within the Room or Break Up the Noise:

- Install an acoustic tile ceiling.
- Install acoustic-absorbing panels (baffles) below ceilings and/or on walls.
- Replace light fixtures or air-conditioning units that "buzz" or produce high levels of noise.
- Turn off equipment when not in use.

Sound Transfer from Outside Activities

Problem

Noise from outside sources, whether it is from vehicles or from students or school activities, can be distracting to students during class time when they are trying to focus.

Strategies

- Install operable windows and exterior doors that are gasketed .
- Eliminate parking adjacent to classrooms.
- Move outdoor activity areas away from classrooms, or schedule so they are not being used during class time.
- Install split air-conditioning compressors away from classroom openings. Locate rooftop units over hallways and other non-classroom areas.
- Install operable windows that can be closed if odors/dust are only periodic occurrences.
- Maintain AC system. AC systems need to be maintained and kept clean and operable, with clean unobstructed air intakes. Unused systems should be removed and vents closed up.

Sport courts should be sited away from classrooms, or schedule use times around class time.

Sounds Transfer Between Rooms

Problem

If walls between classrooms are not insulated, or if they do not go all the way up to the roof structure, sound can be easily transferred between classrooms.

Strategies

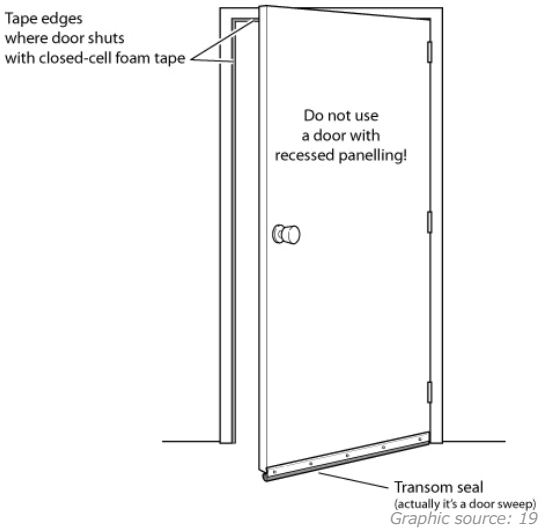
- Enhance noise-reduction ability of dividers.
- Install sound insulation in walls between classrooms.
- Ensure interior walls go to roof structure.
- Provide solid-core doors between classrooms.

Noise travels between classrooms because the building does not have full-height partition walls.

Steps to Control Acoustics for New Classrooms

- Provide full-height insulated walls between classrooms.
- Consider room shape and distance from students to teacher.
- Install gasketed operable windows and doors.
- Locate AC equipment to cause least amount of noise impacts to classrooms.
- Site classrooms away from parking areas, roadways, athletic fields, playgrounds and other sources of noise.
- Insulate interior walls.

Graphic source: 18



Graphic source: 19

Graphic source: 19

Top: *Insulating interior walls helps to reduce noise transfer between rooms.* ***Center and bottom:*** *Gasketed solid core doors reduce noise transfer.*

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Pests

Summary

Pest related impacts are associated with asthma and other diseases. Therefore, controlling pests is important for the health of building occupants, especially where children are present.

Reducing excess moisture will help reduce the likelihood of pests.

Pests Entering Building

Problem

Pests can be reptiles, rodents or birds accessing the attic, flying insects coming in through windows, or roaches, termites and ants entering under doors or through other openings.

Strategies

- Eliminate paths of pest entry.
- Install door sweeps on all exterior doors.
- Block any open spaces around utility pipes entering the building.
- Install screens on all windows and roof vents.
- Ensure attic flashing is secure.
- Move trash dumpsters away from classroom buildings.
- Utilize traps where necessary.
- Retain the services of a pest control contractor to periodically inspect and treat buildings.

Iguanas and other pests enter classroom attics through holes created by damaged flashing.

Graphic source: 16

Right: *Door sweeps can help prevent pests from entering classrooms by sealing the space below exterior doors.* ***Bottom:*** *Once pests are in the attic they can enter classrooms through the ceiling.*

Termites

Problem

In areas where termites are common, schools should establish an extermination program that includes bait systems, scheduled spraying, and a licensed pest control contractor on call to treat any areas where termites are seen.

Strategies

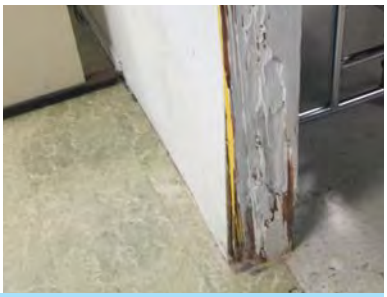
- Use only pre-treated wood for renovations or repairs.
- Eliminate sources of moisture. Remove all debris that may trap moisture and dirt.
- Provide a minimum 6" gap between all wood elements and the earth to deter termite infestation.
- Install bait systems to kill termite colonies.
- Retain the services of a termite exterminator to periodically inspect and treat buildings.

Design Strategies for Pest Control

- Install passive termite barriers such as Termimesh or Basaltic Termite Barrier (BTB) for newly constructed buildings or additions.
- For existing buildings, install termite bait systems around building perimeters. Retain the services of a pest control contractor to periodically inspect and treat buildings.
- Use only pre-treated wood.
- Use alternate materials that are not susceptible to termite damage such as concrete, metal or fiberglass.

Graphic source: 17

Top: *Termites can damage almost any wood element, including furniture and fixtures.* ***Right:*** *Termite damage to a door frame.*



Termite Colony Facts

- There are many different types of termites; some are more destructive than others. The species that causes the most damage is the subterranean termite.
- Colonies require a source of water to thrive.
- Termite colonies can have up to 15,000,000 termites.

Additional Resources

Integrated Pest Management Systems for Schools – US EPA
http://www2.epa.gov/managing-pests-schools

Integrated Pest Management – National Pest Management Association
http://www.whatisipm.org/schools_IPM.asp

Implementation Strategies

EXISTING BUILDING IMPROVEMENTS

Nationwide, 53% of public primary and secondary schools report needing to spend money on repairs, renovations and modernizations to keep their school buildings in good overall condition. In the US Territories, nearly all existing classroom buildings have some aspect that can be modified to improve the Indoor Environmental Quality (IEQ).

This IEQ guidebook helps identify specific issues and offers strategies for addressing those issues. Some strategies can be implemented by teachers, others can be handled at the school level – with a small budget and maintenance staff support. However, some IEQ issues are more challenging and are best addressed at the Central Office level.

As IEQ is positively correlated with academic outcomes, school administrators are encouraged to periodically revisit the condition of the classroom and use the self-evaluation checklists (Appendix B) on an annual basis to help determine when improvements are needed.

WHOLE BUILDING VS. PHASED APPROACH

The decision of whether to tackle IEQ improvements in smaller steps or in one larger multi-room project will depend on several factors including the number of changes required, the complexity and cost of those changes, and available funding. Simple tasks like removing paper from windows can be easily done by maintenance staff or a teacher, but acquiring and installing interior shading devices will require some funding and installation work, although this task could potentially be done one room at a time, where needed. Replacing air conditioning systems or installing dropped ceilings are larger tasks requiring substantial funding, and would be better done as whole building or multi-building projects due to cost, the training required for installation, and the likelihood of reducing per-room costs as the overall size of the project increases. Departments overseeing facility management and school administrators should review the projects needed at their school to determine the scale of projects and potential funding sources. Factors to consider:

- Which projects should be a priority?
- Which projects can be done in-house by teachers and/or school maintenance staff?
- Which projects should be done by DOE/DPW staff or outside contractors?
- Which projects will require professional design and a contractor?
- Which projects can be funded using existing school funding?
- Which projects require additional project funding from departments overseeing facility management or other sources?

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MISCELLANEOUS PHOTOS

All unattributed photos and graphics were provided by the Insular ABCs team.

Appendix A

Summary

Coastal Environmental Challenges and other considerations affecting tropical schools Interior Environmental Quality (IEQ).

Coastal Environment Challenges

Hot-humid Climate Considerations

Many school buildings constructed in the 1950 to 1970s were built without air-conditioning. These buildings designed for natural ventilation typically have large volume/high ceilings, pitched roofs, large window openings, louvered windows, and are oriented on the site to maximize cross-ventilation.

Harsh environmental conditions typical at school

Table 1: Environmental Challenges Unique to Schools in the Tropics

Environmental Conditions	Description
High solar radiation	More intense levels of ultraviolet light (than the continental US) results in rapid deterioration of most non-metallic roofing materials, paints, sealants, elastomeric coatings, and wood. High temperatures in building cladding and structural systems requires careful detailing of joints.
High humidity	Humid conditions promote mold and mildew growth that promote wood decay and accelerate rust. Many paints do not perform well in high humidity conditions. Vapor barriers within the building envelope require careful detailing, especially for air-conditioned buildings.
Intense rain periods and storm surges	This includes prolonged periods of rain and short, intense rainfall that causes flooding or ponding water. Structural stability, protection of openings, as well as protection from rust, and water infiltration into buildings are primary challenges.
Elevated temperatures	Prolonged high temperatures combined with high humidity can severely deteriorate building materials, especially paints, wood, and asphalt-based products.
Salt-laden air	Salt accelerates deterioration of wood, rusts metal (causing pitting in many aluminum alloys) and causes concrete spall (in inadequately protected steel rebar). Salty environments adversely affect the application of paints, sealants, elastomeric coatings, and asphalt roofing.
Pests	Insects, especially subterranean termites can rapidly destroy wooden buildings, damage electrical equipment and roofing materials.

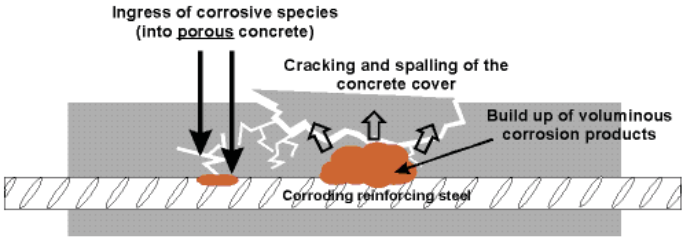
Corrosion of Metal in Marine Environments

Salty marine air will corrode nearly all exposed metals, but some metals or coatings are more resistant. There are several ways to help minimize the deterioration of metal elements such as window and door hardware and frames, railings, connectors, reinforcing, flashings, gutters, etc. either by the choice of materials, or by the method of treatment or maintenance:

- Use galvanized steel or stainless steel for fasteners, gutters, flashings, railings, doors, window and door frames
- Use aluminum doors, windows, and hardware
- Keep metal elements painted
- Ensure steel rebar reinforcing is properly embedded within concrete
- Use alternate materials for construction materials such as Fiberglass Reinforced Polymers (FRP) or vinyl
- Do not use non-galvanized steel

Spalls

Spalls are pieces of concrete or masonry that have delaminated from the surface of a wall, slab, column, or other component. Spalls generally start when moisture gets into the concrete over an extended period of time. This causes corrosion of the reinforcing steel bars, which then expand, causing the concrete to break apart.



Corrosion of steel column by marine environment.

Unpainted aluminum door resists corrosion well.

Moisture

Coastal environments are typically subject to issues caused by high humidity, regular rains, and frequent storms. Site and building designs must plan for ways to manage and remove water, and building materials should be selected to tolerate moisture and deter the formation of mold.

- Covered walkways are necessary due to frequent rains
- Site must be graded to manage runoff and direct water away from buildings and foundations
- Roof downspouts and gutters must be regularly maintained and kept free of debris and plants
- Window and doors (i.e. gaskets, door thresholds, weather stripping) should be designed to keep out wind-driven water
- Add a mildewcide to paint
- Moldy areas should be immediately cleaned with mildewcide or bleach
- Ventilation of rooms is a necessity

Construction for Storm Frequented Areas

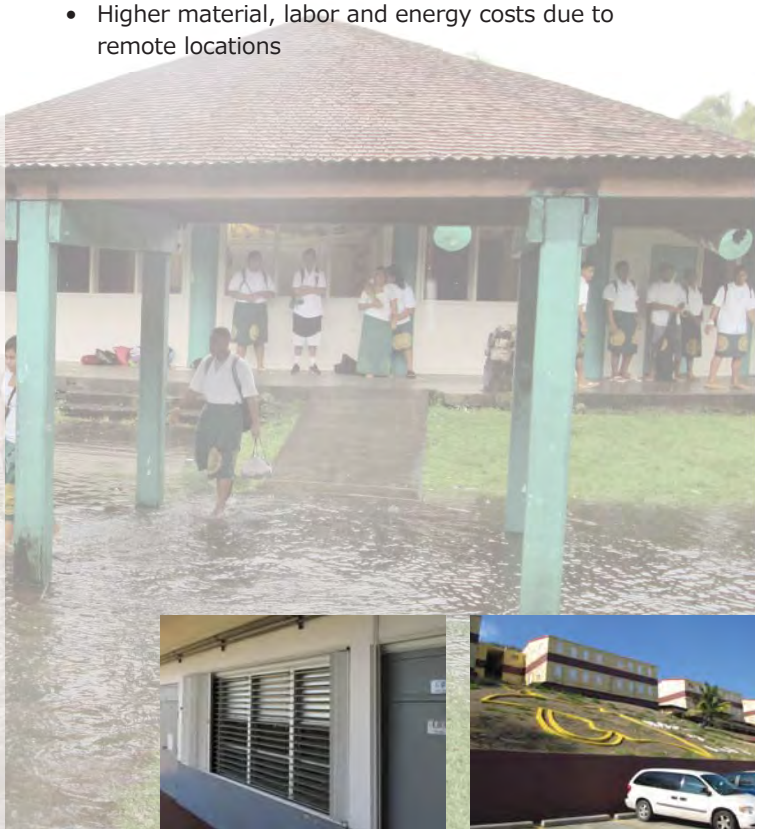
Tropical areas are typically within the zones for hurricanes (typhoons), and building designs and material selections should be chosen with this in mind. This might often impact the ability to fully maximize optimal designs for IEQ issues. Designs in storm-frequent areas should include

- Impact-resistant windows & storm shutters
- Appropriate structural connections
- Reinforced concrete construction where possible

Mountain/Coastal Site Challenges

Many of the existing and potential sites for schools in the US Territories have additional challenges due to their location on steep mountainous sites or close proximity to the ocean. Addressing these issues may provide additional challenges when designing for optimal Indoor Environmental Quality. These issues may include:

- Flooding
- Storm water drainage
- Natural Hazards – tsunamis, hurricanes (typhoons), earthquakes
- Transportation, site circulation, evacuation routes and emergency response access
- Availability and routing of utilities
- Higher material, labor and energy costs due to remote locations



Background: *Site drainage is a challenge for many schools.* ***Center:*** *Storm shutters can reduce damage to windows.*
Right: *Steep slopes present unique challenges for schools.*

Other Considerations

Modifying Historic Buildings

Some of the US Territory schools have historic buildings and structures, most of which are in use. Some, such as the WWII Japanese water tanks on Saipan, have been abandoned, but many historic buildings, which are 50 years old or older, are still in service.

Each Territory has an established method for governmental review of projects affecting historic buildings. Building occupants and users should also recognize that their actions can affect the integrity of historic buildings, and should inquire before making any modifications, drilling into walls, or doing any activity that could negatively affect the historic integrity of the building.

World War II water tank is considered a historic structure.

This historic building is considered significant, which may require special considerations for repair work or alterations.

Hazardous Materials – Asbestos And Lead

Older buildings on school campuses may contain asbestos or lead paint. School users should not drill, cut, scrape or disturb building materials until they confirm there will be no asbestos or lead paint hazard.

Asbestos

The US Environmental Protection Agency (EPA) estimates that most of the nation's primary and secondary schools contain asbestos-containing material. Asbestos is a material made of fibrous minerals that was used for many years in roofing shingles, floor tiles, and fire-resistive insulation. Intact and undisturbed asbestos-containing materials (ACM) do not generally pose a health hazard, but they may become hazardous if they are damaged or disturbed, or if they deteriorate over time and release asbestos fibers in the air.

Educational agencies are required to inspect schools for ACM and to prepare management plans to prevent or reduce asbestos hazards. All school building operations and maintenance staff should review the management plan.

Once areas that contain asbestos are identified, it is important that day-to-day activities such as repair or maintenance work, do not disturb the ACM.

Asbestos is found in many building products, including pipe insulation.

Lead-Based Paint
All pre-1978 buildings should be tested for lead paint prior to renovation or work that will disturb paint.

Even low levels of lead in the blood of children can result in:

- Behavior and learning problems
- Lower IQ and Hyperactivity
- Slowed growth
- Hearing Problems
- Anemia

In older buildings, school staff should examine walls, interior and exterior surfaces for cracking, chipping or peeling paint and check areas on doors or windows were painted surfaces may rub together.

Common renovation and repair activities can create hazardous lead dust and chips. Proper work practices can help protect children and school staff. Federal law requires that if you or someone of your staff is performing work (including routine maintenance that disturbs paint), the organization must be Lead-Safe Certified.

Protective work practices include:

- Containing the work area,
- Avoiding renovation methods that generate large amounts of lead-contaminated dust, and
- Cleaning up thoroughly.

Preventive Maintenance

A maintenance program that includes a proactive schedule of Preventive Maintenance tasks will help overall lifecycle costs and generate operational savings in the long term.

While the run-it-'til-it's broke approach to maintenance budgeting saves money in the short-term, it leads to more costly repairs in the long term and more frequent disruptions when key components unexpectedly fail.

Additional Resources

Additional Resources:

US EPA website on Asbestos and School Buidlings:
http://www2.epa.gov/asbestos/school-buildings

US EPA. 1996. How to Manage Asbestos in School Buildings: The AHERA Designated Person's Self Study Guide.
http://www2.epa.gov/asbestos/how-manage-asbestos-school-buildings-ahera-designated-persons-self-study-guide-0

US EPA. n.d. Renovation, Repair and Painting for Child-Care Providers.
http://www2.epa.gov/lead/renovation-repair-and-painting-child-care-providers

US Dept of Defense. 2006. United Facilities Criteria (UFC) Tropical Engineering, Change 2.
www.wbdg.org/ccb/DOD/UFC/ufc_3_440_05n.pdf

Collaborative for High Performing Schools, 2004. Best Practices Manual Volume IV: M&O (Maintenance and Operations).
http://www.boccentral.org/sites/default/files/documents/CHPS_M_O_Best_Practices_Manual.pdf

Buildings built before 1978 should be tested for lead-based paint.

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Appendix B

Self-Assessment Checklists

Questions to assist self-guided assessments related to thermal comfort, light levels, air quality, acoustics, and pests

How can we find IEQ concerns?

Questions to aid identification

The following lists can be used by school principals, teachers, administrators, and facility managers to help consider and identify possible IEQ problems. As problems are identified, the IEQ Handbook can be used to explore ways to address the issues. In many cases, low cost readily achievable steps can be taken to improve conditions.

Technical knowledge may be required to answer some of the questions, but a careful look and a discerning eye can go a long way, and understanding the problems is a great step forward in preventing or addressing IEQ concerns. Annual assessment is recommended to help catch new problems early.

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Thermal Comfort

NATURALLY VENTILATED CLASSROOM

DESCRIPTION	YES	NO
Are all windows operable and functioning properly?		
Is the area of windows large enough and is there cross-ventilation (windows on at least two sides of the room)?		
Does the classroom have fans and do they appear to be of adequate number and in good repair?		
Is there a ventilated crawl space or another occupied space under the floor?		
Are windows and doors open to natural air flow, i.e. adjacent buildings or vegetation do not block air flow through the room?		
Is the classroom free of significant areas of heat-absorbing surfaces adjacent to the building, especially on the windward side, that could be contributing to heat load in the classroom?		
Are windows free of direct solar load for an appreciable portion of the day? For example, are they north facing or have exterior shading devices?		
Are there window shading devices inside?		
If the windows are glazed, (not wood jalousies) is the glass tinted, either with applied film or integrally?		
Are the walls exposed to direct sun either insulated or of a high mass?		
Is the roof insulated or is this a first floor classroom with another occupied space above?		
If ceilings are vaulted, are they adequately ventilated?		

AIR-CONDITIONED CLASSROOM

DESCRIPTION	YES	NO
Are windows operable (in case AC fails)?		
Are windows free of direct solar load for an appreciable portion of the day? (Are they north facing or have exterior shading devices)		
Is there cross-ventilation (windows on at least two sides of the room)?		
Are there window shading devices inside?		
If the windows are glazed, (not wood or metal jalousies) is the glass tinted, either with applied film or integrally?		
Are the walls exposed to direct sun either insulated or of a high mass?		
Is the roof insulated or is this a first floor classroom with another occupied space above?		

Is the building envelope adequately sealed to reduce moisture (both vapor and water) transmission?		
Is the building free of any signs of mildew on the interior of the building?		

Light Levels

DESCRIPTION	YES	NO
Does the light level appear to be adequate?		
Is the light level relatively uniform in the space, with no darker spots?		
Is the room without apparent glare problems, either due to point-source artificial lighting or from sunlight coming through windows?		
Are all the light fixtures working?		
Do the lighting controls allow for any differential lighting (e.g. do lighting controls allow for turning off lights closer to windows, while keeping lights on for spaces farther from windows)?		
Is the color temperature of the lamps in the fixtures warm?		
Are wall surfaces generally a light color and reflective of light? Are they a warm, pleasing color?		

Air Quality

DESCRIPTION	YES	NO
Are there door mats or grates between exterior and interior?		
Is the room free of odors?		
Is the room free of observed or reported use of air fresheners, scented candles, incense, pesticides, treated fabrics or other odor-producing elements?		
Is the room free of excessive clutter or trash, either in the classroom or immediately outside that could be an odor source?		
Is the room clean, without excessive dust?		
Is the room free of observable mildew on walls?		
If air-conditioned, are the air vents clean?		
Does the room atmosphere seem fresh, i.e. not musty or stuffy?		
Is the room free of any signs of friable asbestos products?		
If an older building, is the paint in good condition?		
Is the room free of any animal pets in the classroom that might be responsible for allergic reactions?		
If cleaning agents can be determined, are they non-toxic?		

Is the school in an area that has no radon gases in the soil, OR is well ventilated and built with an open crawl space between habitable spaces and the ground?		
Is the classroom free of vehicle exhaust from nearby streets or drop-off points?		
If mechanically ventilated, are outside air intakes free of exposure to any air pollutants, either from vehicles, bathroom vents or exhaust from other systems?		
Do school labs appear to control hazardous materials well? Do school labs have vent hoods?		
Are there door mats or grates between exterior and interior?		

Acoustics

DESCRIPTION	YES	NO
Is the classroom free of noticeable sound transmission between classrooms or other adjacent spaces through common walls? Make this evaluation during class time.		
Is the classroom free of any noticeable background noises that would be considered bothersome: mechanical equipment noises, ballasts hums, outside noise sources?		
Can any of the noises above be abated relatively simply?		
If the acoustical environment appears to be a problem, are there relatively simple things that could be done to improve the situation? These may include adding acoustical absorption to ceiling, walls, sealing cracks in movable partitions between classrooms, replacing moveable partitions with fixed, insulated walls where moveable partitions are no longer used, etc.		

Pests

DESCRIPTION	YES	NO
Are there visible signs of damage from pests (e.g., insects, rodents, birds, or reptiles)?		
Are pest droppings visible?		
Are entry ways that pests could use to access a building or room visible, such as holes or large cracks in walls and spaces under doors?		

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Appendix C

IEQ Issues by Building

Tabular listing of IEQ issues identified during the Phase II assessments that could be addressed in the repair program or other initiatives

Phase II IEQ issues for future action

Short list for reference

The following is a listing of types of concerns and their locations by school and building as identified in the 2012-2013 Phase II condition assessments. It is acknowledged that some of these items have already been addressed, but a thorough update of IEQ information was beyond the scope of the Phase III effort.

Incorporation of the actions to address these issues was considered in the development of the Phase III Year 1 deferred maintenance reduction work plans. Due to funding limitations of the deferred maintenance reduction program (DMRP), focused efforts to address specific IEQ issues is not feasible, but the DMRP team continues to look for opportunities to incorporate the recommendations made herein during the execution of planned repair projects as funding allows.

These tables indicate where issues will or could be addressed by DMRP projects. Possibilities also exist to incorporate some of these items into energy savings performance contracts if such opportunities arise. The DMRP team will continue to consider the feasibility of these types of innitiatives.

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AMERICAN SAMOA – IEQ Issues Identified in Phase II and Locations

IEQ Issue	School	Building	Covered in DM
Thermal Comfort			**Yes**
Inoperable/ broken/ inadequate windows	Samoana HS Matafao ES Coleman ES Aua ES Laulii ES Fagaitua ES Manu'a HS Olosega ES Matatula ES Nu'uuli Polytech HS Tafuna HS Pavaia'i ES Lupulele ES Siliaga ES Leone HS Leone Midkiff ES Alataua ES	Buildings 3, 7, 8 Building 5, 17 Buildings 1, 11, 14 Building 2 Buildings 5-8 Buildings 1, 3, 4, 6 Building 9 Buildings 1, 2, 5 Buildings 1-3 Building 3, 7 Buildings 10-17 Buildings 13-20 Buildings 1, 2, 6, 12, 13, 16-18 Buildings 1, 2, 4 Buildings 3, 5, 6, 10, 11 Building 7 Building 15	Yes
Missing/ inadequate Roof Insulation	Samoana HS Leatele ES Matafao ES Coleman ES Afonotele ES Mt. Alava ES Aua ES Laulii ES Fagaitua ES Masefau ES Fitiuta ES Manu'a HS Faleasao ES Olosega ES Alofau ES Olomoana ES Manulele ES Nu'uuli Polytech HS Tafuna HS Pavaia'i ES Lupulele ES Siliaga ES Leone HS Leone Midkiff ES Alataua ES	Buildings 2-9 Buildings 1, 4, 5, 10 Buildings 3, 5-11, 13, 16, 17 Buildings 1, 3-7, 9-14, 20, 23, 24 Buildings 2, 3, 5 Buildings 1, 3-5, 8 Building 1, 2, 5-10 Buildings 2, 3, 5-8 Buildings 1, 4, 6 Building 1 Buildings 1, 3, 4 Buildings 7-10 Buildings 2-5 Buildings 1-3, 5, 6, 8 Buildings 1, 6, 8-11 Buildings 1, 3-7 Buildings 1, 4, 5, 8, 9, 11-17 Building 3, 7 Buildings 2, 3, 6, 8, 23 Buildings 3-6, 7, 13-20 Building 1-4, 6 Building 4 Buildings 14, 17 Building 1, 3, 5, 6, 7-16 Building 15	No
Ceiling fans not working/	Samoana HS	Buildings 2, 4	No

IEQ Issue	School	Building	Covered in DM
missing/ inadequate	Leatele ES Matafao ES Coleman ES Afonotele ES Mt. Alava ES Aua ES Laulii ES Fagaitua ES Fitiuta ES Manu'a HS Faleasao ES Olosega ES Alofau ES Olomoana ES A.P. Lutali Anu'u ES Tafuna ES Manulele ES Nu'uuli Polytech HS Tafuna HS Pavaia'i ES Lupulele ES Siliaga ES Leone HS Leone Midkiff ES Alataua ES	Buildings 1, 4, 5, 10 Building 5 Buildings 1, 3-7, 9-14, 23, 24 Building 5 Buildings 1, 3-5 Building 1, 2, 5-10 Buildings 2, 5-8 Buildings 4, 6 Buildings 1, 3, 4 Buildings 7-10 Buildings 2-5 Buildings 1-3, 5, 6, 8 Buildings 6, 8-11 Buildings 3-7 Buildings 4, 5 Buildings 3-9 Buildings 1, 4, 5, 8, 9, 11-17 Building 2, 3, 7 Buildings 2, 3, 6, 8, 10-17, 23 Buildings 3-6, 8, 13-20 Buildings 3, 4, 12, 13, 16-18 Buildings 1, 2, 4 Buildings 3, 5, 6, 10, 11 Building 1, 3, 5, 7-16 Buildings 2-4, 6, 15	
Unused/ needed Ridge vents	Mt. Alava ES Aua ES Masefau ES Alofau ES Olomoana ES	Buildings 1, 3-5, 8 Building 2 Building 1 Buildings 1, 6, 8-11 Buildings 1, 3-7	No
Inoperable/ malfunctioning/ inadequate A/C	Samoana HS Matafao ES Coleman ES Afonotele ES Laulii ES Fagaitua ES Tafuna HS Leone HS	Buildings 7, 9 Building 3 Building 11, 14 Building 5 Building 3, 6 Building 9 Buildings 2, 3, 6, 8, 10-17, 23 Building 15	Yes
Building siting/ location prevents natural ventilation	Nu'uuli Polytech HS	Building 9	Yes
Window tint needed	Not applicable		
Light Levels			
Interior or exterior window shades needed	Samoana HS Matafao ES Coleman ES	Buildings 4, 6, 8 Building 16 Building 23	No

IEQ Issue	School	Building	Covered in DM
	Matatula ES	Buildings 1-3	
	Nu'uuli Polytech HS	Building 1, 2, 3, 7, 9	
	Pavaia'i ES	Buildings 3-6, 7, 13-20	
	Siliaga ES	Building 4	
Differential light controls needed	A.P. Lutali Anu'u ES	Buildings 4, 5	No
	Nu'uuli Polytech HS	Building 1, 2, 7, 9	
	Pavaia'i ES	Building 7, 13-20	
	Siliaga ES	Buildings 1, 2	
	Leone HS	Buildings 3, 5, 6, 10, 11	
Opaque louvers/ shutters block natural light	Not applicable		
Windows covered with boards/ paper	Leatele ES	Building 1	No
	Matafao ES	Building 16	
	Coleman ES	Building 23	
	Afonotele ES	Buildings 2, 3, 5	
	Mt. Alava ES	Buildings 1, 3-5, 8	
	Aua ES	Building 1, 2, 5-10	
	Masefau ES	Building 1	
	Fitiuta ES	Buildings 1, 3, 4	
	Manu'a HS	Buildings 7-10	
	Faleasao ES	Buildings 2-5	
	Olosega ES	Buildings 1-3, 5, 6, 8	
	Alofau ES	Buildings 1, 6, 8-11	
	Olomoana ES	Buildings 1, 3-7	
	Matatula ES	Buildings 1-3	
	Tafuna ES	Buildings 3-9	
	Manulele ES	Buildings 1, 4, 5, 8, 9, 11-17	
	Nu'uuli Polytech HS	Building 1, 2, 7	
	Tafuna HS	Buildings 2, 3, 6, 8, 10-17, 23	
	Pavaia'i ES	Buildings 3-6, 7, 8	
	Lupulele ES	Buildings 1, 2, 4, 6	
	Siliaga ES	Building 4	
	Leone HS	Building 15	
	Leone Midkiff ES	Building 1, 3, 5-16	
	Alataua ES	Building 15	
Inoperable/ inadequate light fixtures	Samoana HS	Building 7	Yes in some cases
	Leatele ES	Building 1	
	Matafao ES	Building 16	
	Coleman ES	Building 1, 3-7, 9-14, 23, 24	
	Mt. Alava ES	Buildings 1, 3-5	
	Aua ES	Buildings 1, 2, 5-10	
	Laulii ES	Building 3	
	Fagaitua ES	Building 3, 9	
	Fitiuta ES	Buildings 1, 3, 4	
	Manu'a HS	Buildings 7-10	
	Faleasao ES	Buildings 2-5	

IEQ Issue	School	Building	Covered in DM
	Olosega ES Tafuna ES Manulele ES Nu'uuli Polytech HS Tafuna HS Pavaia'i ES Lupulele ES Siliaga ES Leone HS Leone Midkiff ES Alataua ES	Buildings 1-3, 5, 6, 8 Buildings 3-9 Building 1, 4, 5, 8, 9 Building 2, 3 Buildings 2, 3, 6, 8, 10-17, 23 Building 7 Buildings 1, 2, 6, 12, 13, 16-18 Building 1 Building 15 Building 1, 3, 5-16 Buildings 2-4, 6	
Light lamping inappropriate/ not uniform	Samoana HS Masefau ES Alofau ES Olomoana ES	Buildings 2, 3, 5, 8 Building 1 Buildings 6, 8-11 Buildings 3-7	No
Light covers broken/ missing	Manu'a HS Faleasao ES Alofau ES Olomoana ES Manulele ES	Building 9 Buildings 2-5 Buildings 6, 8-11 Buildings 3-7 Buildings 11-17	Yes in some cases
Classroom interior paint too dark	Nu'uuli Polytech HS	Building 7	No
Air Quality			
Unclean air diffusers	Nu'uuli Polytech HS	Building 7	Yes in some cases
Carpet needs replacement	Nu'uuli Polytech HS	Building 7	Yes in some cases
Remove mold/ mildew	Leatele ES Matafao ES Coleman ES Olosega ES Matatula ES A.P. Lutali Anu'u ES Tafuna ES Manulele ES Nu'uuli Polytech HS Tafuna HS Pavaia'i ES Siliaga ES Leone HS Leone Midkiff ES Alataua ES	Buildings 4, 5, 10 Building 17 Building 3 Buildings 1, 2, 5 Buildings 1-3 Buildings 4, 5 Buildings 3-9 Buildings 4, 5, 8, 9 Building 1, 2 Buildings 2, 3, 6, 8, 10-17, 23 Buildings 3-6 Buildings 1, 2, 4 Buildings 14, 15, 17 Building 1, 3, 7-16 Buildings 2-4, 6	Yes in some cases
Odors in classrooms	Coleman ES Mt. Alava ES Leone Midkiff ES	Building 1, 20 (test soil) Building 5, 8 Building 1	Yes in some cases
Classroom has leak/ drainage issue	Matafao ES Fagaitua ES	Building 17 Buildings 1	Yes in some cases

IEQ Issue	School	Building	Covered in DM
	A.P. Lutali Anu'u ES Nu'uuli Polytech HS	Buildings 4, 5 Building 7	
Dust/ dirt building in Classroom	Aua ES Laulii ES Fagaitua ES Nu'uuli Polytech HS Leone Midkiff ES	Building 1 Building 2 Building 9 Building 2 Building 7	No
Unclean/ garbage/ dusty around classroom	Aua ES Laulii ES A.P. Lutali Anu'u ES Manulele ES Nu'uuli Polytech HS Leone HS	Building 2, 5-10 Buildings 5-8 Buildings 4, 5 Building 1 Building 7 Building 15	No
Inadequate/ lacking Window screens	Leatele ES Fitiuta ES Manu'a HS Olosega ES Alofau ES Tafuna ES Tafuna HS Pavaia'i ES Siliaga ES	Buildings 4, 5, 10 Buildings 1, 3, 4 Buildings 7-10 Buildings 1-3, 5, 6, 8 Buildings 6, 8-11 Buildings 3-9 Buildings 2, 3, 6, 8, 23 Buildings 3-6 Building 4	Yes in some cases
Vehicles parking/ driving next to classrooms	Coleman ES Nu'uuli Polytech HS Siliaga ES Leone Midkiff ES Alataua ES	Buildings 3-7, 9-13, 20, 24 Building 3, 7 Buildings 1, 2 Building 1, 7-15 Buildings 2-4, 6	No
Noise			
A/C equipment too noisy	Laulii ES Fagaitua ES	Building 3 Buildings 1	No
Interior/ exterior wall partitions or insulation needed	Leatele ES Coleman ES Manu'a HS Faleasao ES Leone Midkiff ES	Buildings 4, 5, 10 Building 14 Buildings 7-10 Buildings 2-5 Building 1, 7	No
Building proximity produces noise	Coleman ES	Buildings 4-7, 9-13, 23, 24	No
Gasketed windows or doors needed	Samoana HS Leatele ES Coleman ES	Buildings 3, 4, 5, 6 Buildings 1, 4, 5, 10 Building 1	Yes in some cases
Pests			
Pests should be exterminated	Leatele ES Matafao ES Fagaitua ES Tafuna HS Leone HS	Buildings 4, 5, 10 Building 5 Buildings 1, 9 Buildings 10-17 Buildings 3, 5, 6, 10, 11	No

CNMI – IEQ Issues Identified in Phase II and Locations

IEQ Issue	School	Building	Covered in DMRP
Thermal Comfort			
Inoperable/ broken/ inadequate windows	Chacha JHS Dandan ES GT Camacho ES Garapan ES Kagman ES Kagman HS Marianas HS Oleai ES Saipan Southern HS Tanapag ES	9 10 8, 9 5 1, 2, 5, 6 3-6, 8-15 1-4, 6, 11, 13-15, 17 1-3 1-11 12	Yes in some cases
Missing/ inadequate Roof Insulation	Dandan ES GT Camacho ES Garapan ES Koblerville ES Marianas HS Oleai ES Rota HS Rota JHS San Antonio ES San Vincente ES Sinapolo ES Tanapag ES Tinian ES Tinian JHS/SHS Reyes ES	10 2 1, 3, 4, 6, 10 2, 3, 6, 7 1-4, 6 8, 9 2-5 2-5 2 4, 5, 13, 14 3, 4 4, 6 2-4 ,14 1-8 1, 10	No
Missing exterior wall insulation	Hopwood JHS	4, 22	No
Windows not able to be opened	Koblerville ES San Vincente ES Reyes ES	2, 6, 7 4, 13 10	No
Windows leaking out cold air	Garapan ES Koblerville ES Oleai ES San Antonio ES San Vincente ES Tinian ES Reyes ES	1, 3, 4, 6, 7 3 1-4, 8, 9 1, 8 4, 5, 10, 13, 14 2-4, 14 1, 2, 8, 9	No
Windows covered to keep in cooled air	Tanapag ES	4-7, 11	No
Ceiling fans not working/ missing/ Inadequate	Chacha JHS Dandan ES GT Camacho ES GT Camacho ES	5-8 3-7, 10 2 7-9	No

IEQ Issue	School	Building	Covered in DMRP
	Garapan ES	1, 3, 4-6, 7	
	Hopwood JHS	2, 4-6, 8, 11, 12, 22	
	Kagman ES	1, 2, 5, 6	
	Koblerville ES	3, 5	
	Marianas HS	1-4, 6, 11, 13-15, 17	
	Oleai ES	1-3	
	Rota HS	2-5	
	Rota JHS	2-5	
	Saipan Southern HS	1-11	
	San Antonio ES	1, 2, 8, 11	
	San Vincente ES	5, 10, 11, 12, 14	
	Tanapag ES	4-8, 11-13	
	Tinian ES	2-4, 14	
	Tinian JHS/SHS	1-8	
	Reyes ES	1, 2, 8-10, 14	
Window tint needed	Chacha JHS	2, 5, 8, 9	No
	GT Camacho ES	7	
	Kagman HS	3-6, 9-15	
	Marianas HS	11, 13, 15, 17	
Light Levels			
Interior window shades needed	Dandan ES	3-7, 10	No
	GT Camacho ES	7	
	Hopwood JHS	2, 4-6, 8, 11, 12, 22	
	Kagman HS	8	
	Koblerville ES	2, 3, 5- 7	
	Marianas HS	1-4, 6, 11, 13-15, 17	
	Rota HS	2-5	
	Rota JHS	2-5	
	Saipan Southern HS	1-11	
	San Antonio ES	11	
	San Vincente ES	4, 5, 10- 14	
	Sinapolo ES	3, 4	
	Tanapag ES	4-8, 11, 12	
	Tinian ES	2-4, 14	
	Tinian JHS/SHS	1-8	
	Reyes ES	1, 2, 8, 9, 14	
Differential Light controls needed	Marianas HS	11, 13, 15, 17	No
Opaque louvers/ shutters don't allow in natural light	GT Camacho ES	2	No
	Garapan ES	1, 3, 4, 6, 7	
	Hopwood JHS	5, 8, 11	
	Rota JHS	5	
	San Antonio ES	1, 2, 8	
	San Vincente ES	4, 13	
	Tanapag ES	4-8, 11	
	Reyes ES	10	

IEQ Issue	School	Building	Covered in DMRP
Windows covered with boards/ paper	Chacha JHS GT Camacho ES Hopwood JHS Koblerville ES Marianas HS Oleai ES Rota JHS Saipan Southern HS San Antonio ES San Vincente ES Sinapolo ES Tanapag ES Tinian ES Tinian JHS/SHS Reyes ES	5-8 2, 9 4, 5, 8, 11, 22 2, 3, 6, 7 1-4, 6, 11, 13-15, 17 1-3, 8, 9 5 1-11 1, 2, 8, 11 4, 5, 10- 14 3, 4 4-7, 11 2-4, 14 1-8 1, 2, 8-10	No
Inadequate/ inoperable light fixtures	Chacha JHS Garapan ES Kagman ES Rota HS Rota JHS San Antonio ES	6, 7 1, 3, 4, 6, 7, 10 1, 2, 5, 6 2-5 2-5 11	Yes in some cases
Light lamping not uniform/ inappropriate	GT Camacho ES GT Camacho ES Garapan ES Tanapag ES	2 7 1, 3, 4, 6, 7, 10 4-8, 11- 13	No
Light covers broken/ missing			Yes in some cases
Classroom interior paint too dark	Chacha JHS Rota JHS Saipan Southern HS San Antonio ES	5-8 5 1-11 11	No
Air Quality			
Weather seals needed on doors			No
No outside air intake for A/C	Garapan ES	1, 3, 4-6, 7, 10	Yes
Unclean air diffusers	Chacha JHS Dandan ES GT Camacho ES Garapan ES Kagman ES	5-8 3-7 2 5 1, 2, 5, 6	Yes in some cases
Carpet needs replacement	Garapan ES	5	Yes in some cases
Remove mold/ mildew	GT Camacho ES Sinapolo ES Tinian JHS/SHS	2 3, 4 1-8	Yes in some cases

IEQ Issue	School	Building	Covered in DMRP
Mildewed/ broken acoustic ceiling panels	Garapan ES	10	Yes
Classroom has leak/ drainage issue	Rota HS Saipan Southern HS	2-5 1-11	Yes
Old unused A/C units left in place	Not Applicable		
Noise			
A/C equipment too noisy	Garapan ES Oleai ES Reyes ES	1, 3, 4, 6, 7 1-3, 8, 9 2, 8, 9	No
Interior/exterior wall insulation needed	Dandan ES GT Camacho ES Koblerville ES	3-6 8, 9 5	No
Pests			
Pests are present in rooms	Oleai ES	1-3	No

GUAM – IEQ Issues Identified in Phase II and Locations

IEQ Issue	School	Buildings	Covered in DM
Thermal Comfort			**Yes**
Inoperable/ broken/ inadequate Windows	Agueda Johnson MS Astumbo ES CL Taiatano ES Daniel L Perez ES Harry S Truman ES JP Torres Alternative School JQ San Miguel ES Juan M Guerrero ES LP Untalan MS MA Sablan ES Southern HS Upi ES Wettengel ES	3-5, 7, 8 12-14 7, 9-13-15, 17-19 4-7 8, 12 2-4 14 5 8, 10, 29 3-5, 11-13, 16-18 2-6, 8-10 3, 12, 13-19 3-5, 10-12	Yes in some cases
Missing/ inadequate roof insulation	Agana Heights ES Agueda Johnson MS Captain HB Price ES Chief Brodie ES Daniel L Perez ES FB Leon Gurrero MS Finegayan ES Harry S Truman ES JQ San Miguel ES Jose LG Rios ES Juan M Guerrero ES LBJ ES MA Sablan ES MU Lujan ES Maria Ulloa ES Merizo Martyrs Memorial ES Oceanview MS Pedro C Lujan ES Simon Sanchez HS Talofofo ES Upi ES Vicente SA Benavente MS Wettengel ES	2, 4, 5, 6, 7, 12, 13 1, 3-5, 12-14 1, 2, 4, 6, 9, 17 4, 9, 12-18 11, 12 14-21 2-4, 6-10, 14-17, 22-27 1, 4, 6, 7, 8, 10, 12 10, 11 2-4, 6-9, 11, 12, 16, 17 2, 4, 5, 8-10, 20, 21 3, 4, 7, 10, 11 7-10 5-11, 13-16, 23 1, 4, 11-13, 17 1, 4, 6 4-9 1, 5-7, 12, 14 13, 14 2, 7, 12 4, 6, 7, 14-16 4, 6-8, 10, 11, 14-22 3-13	No
Windows leaking out cold air	Agueda Johnson MS Captain HB Price ES Chief Brodie ES Daniel L Perez ES Finegayan ES	3-5, 7, 8 14 6, 7, 9 4-7 2-4, 6-11	No

IEQ Issue	School	Buildings	Covered in DM
	JP Torres Alternative School	2, 3	
	Juan M Guerrero ES	2, 4, 5, 8-12, 19	
	MU Lujan ES	11, 14-16, 20-22	
	Oceanview MS	5, 6	
	Vicente SA Benavente MS	4, 6-8, 10, 11	
Windows covered to keep in cooled air	Agana Heights ES	2, 5, 12, 13	No
	Finegayan ES	2-4, 11	
	Harry S Truman ES	1, 4	
	LBJ ES	10, 11	
	MA Sablan ES	19-23	
	Maria Ulloa ES	1, 4, 8-10, 12, 17, 20, 22, 23	
	Oceanview MS	4, 7-9	
	Talofofo ES	2, 7, 12	
Ceiling fans not working/ missing/ inadequate	Harry S Truman ES	1, 4, 8, 12	No
	JP Torres Alternative School	2-4	
	Juan M Guerrero ES	2, 4, 5, 8-17, 19-21	
	MA Sablan ES	3-5, 7-23	
	Machananao ES	2-7	
	Maria Ulloa ES	1, 4, 8-13, 17, 20, 22, 23	
	Oceanview MS	4-10, 12-22	
	Upi ES	3, 4, 6, 7, 12, 13-19	
	Vicente SA Benavente MS	4, 6-8, 10, 11, 14-22	
	Wettengel ES	3-13	
Inoperable/ malfunctioning/ inadequate A/C	Agueda Johnson MS	1, 3-5, 7, 8	Yes
	Daniel L Perez ES	4-8, 10	
	FB Leon Gurrero MS	3-6	
	Inarajan ES	4-6	
	Jose LG Rios ES	5	
	LP Untalan MS	8, 10, 29	
	MU Lujan ES	5-10	
	Machananao ES	2-7	
	Merizo Martyrs Memorial ES	5	
	Simon Sanchez HS	2, 8, 18	
	Talofofo ES	2, 7, 12-14	
Window tint needed	CL Taiatano ES	4-6, 8, 15	No
	BP Carbullido ES	12-18	
	Daniel L Perez ES	8, 10, 12	
	Finegayan ES	14-17, 22-27	
	George Washington HS	3-6, 8	
	Inarajan MS	7	
	LP Untalan MS	7	
	LBJ ES	3, 4	
	MU Lujan ES	5-10, 13, 23	
	Simon Sanchez HS	1-4, 11-14	
	Talofofo ES	13, 14	

IEQ Issue	School	Buildings	Covered in DM
	Tamuning ES	1, 3	
Light Levels			
Interior or exterior window shades needed	Agana Heights ES Agueda Johnson MS Astumbo ES CL Taiatano ES Daniel L Perez ES Finegayan ES Harry S Truman ES Juan M Guerrero ES LP Untalan MS MA Sablan ES MU Lujan ES Machananao ES Maria Ulloa ES Oceanview MS Simon Sanchez HS Southern HS Tamuning ES Upi ES Vicente SA Benavente MS Wettengel ES	2, 5, 12, 13 1, 3-5, 7, 8, 12-14 2-9 4-6 4-8, 10, 12 6-10, 14-17, 22-27 1, 4, 6, 7, 10 2, 4, 5, 8-17, 19-21 7 3-5, 7-23 5-10, 13, 23 2-7 1, 4, 8-13, 17, 20, 22, 23 4-10, 12-22 1-4 2-6, 8-10 1, 3 3, 4, 6, 7, 12, 13-19 4, 6-8, 10, 11, 14-22 3-13	No
Differential light controls needed	Agueda Johnson MS Daniel L Perez ES George Washington HS Juan M Guerrero ES Wettengel ES	7, 8 4-7 16 2, 4, 5, 8-10 6-9, 13	No
Opaque louvers/ shutters don't allow in natural light	Agana Heights ES CL Taiatano ES Captain HB Price ES Chief Brodie ES FB Leon Gurrero MS Finegayan ES George Washington HS JP Torres Alternative School JQ San Miguel ES LP Untalan MS LBJ ES MU Lujan ES Machananao ES Oceanview MS Ordot-Chalan Pago ES Pedro C Lujan ES Wettengel ES	3, 4, 9 7, 9-13, 17-19 1, 2, 4, 6-8, 14 4 3-9, 12 2-5, 6-11, 14-17, 22-27 1, 3-6, 8, 9, 10, 14, 17-21, 24-26 2-4 2, 4, 6, 7, 9, 12 8, 10 1, 2, 6 20-22 2-7 10, 12-22 4, 6-10 1, 2, 5-7, 12, 14 6-9, 13	No

IEQ Issue	School	Buildings	Covered in DM
Windows covered with boards/ paper	Agueda Johnson MS	3-5, 7, 8	No
	Astumbo ES	12-14	
	CL Taiatano ES	4-6	
	BP Carbullido ES	4, 5, 13	
	Chief Brodie ES	9	
	Daniel L Perez ES	4-7	
	Finegayan ES	2-5, 6-11, 14-17, 22-27	
	Harry S Truman ES	12	
	JP Torres Alternative School	2, 3	
	Juan M Guerrero ES	2, 4, 5, 8-17, 19-21	
	LBJ ES	8, 12, 13, 16-18, 20	
	MA Sablan ES	7-10, 14, 15, 19-23	
	MU Lujan ES	5-10	
	Machananao ES	2-7	
	Maria Ulloa ES	1, 4, 8-13, 17, 20, 23	
	Merizo Martyrs Memorial ES	5	
	Oceanview MS	4, 7-10	
	Ordot-Chalan Pago ES	1, 2	
	Southern HS	2-6, 8-10	
	Upi ES	3, 4, 6, 7, 12, 13-19	
	Vicente SA Benavente MS	4, 6-8, 10, 11	
	Wettengel ES	3-13	
Inadequate/ inoperable light fixtures	Agana Heights ES	2, 5, 12, 13	Yes in some cases
	Agueda Johnson MS	1, 3-5, 7, 8	
	BP Carbullido ES	1, 4, 5, 9, 12, 13	
	Chief Brodie ES	4, 7	
	Daniel L Perez ES	4-7, 12	
	Harry S Truman ES	12	
	Inarajan ES	4-6	
	JQ San Miguel ES	2, 4, 6, 7, 9-12, 14	
	Jose LG Rios ES	2-9, 11, 12, 16, 17	
	LP Untalan MS	8, 10	
	LBJ ES	1, 2, 6	
	MU Lujan ES	5-10, 13, 20-23	
	Maria Ulloa ES	22	
	Merizo Martyrs Memorial ES	1, 4, 6, 11-15	
	Simon Sanchez HS	5-10, 18	
	Southern HS	2-6, 8-10	
	Talofofo ES	2-4, 6, 7, 12-14	
	Tamuning ES	1, 3	
Light lamping not uniform/ inappropriate	Agana Heights ES	2-6, 7, 9, 12, 13	No
	Agueda Johnson MS	1, 3-5, 7, 8, 11	
	CL Taiatano ES	4-6, 7, 9-13, 17-19	
	Captain HB Price ES	1, 2, 4, 6-8, 14	
	BP Carbullido ES	1, 4, 5, 8, 13, 15	
	Daniel L Perez ES	4-7, 11, 12	
	FB Leon Gurrero MS	3-9, 12	

IEQ Issue	School	Buildings	Covered in DM
	George Washington HS Inarajan ES Inarajan MS JQ San Miguel ES Jose LG Rios ES MU Lujan ES Merizo Martyrs Memorial ES Ordot-Chalan Pago ES Ordot-Chalan Pago ES Pedro C Lujan ES Simon Sanchez HS Talofofo ES Tamuning ES Vicente SA Benavente MS	1, 3-6, 8, 9, 10, 14, 17-21, 24-26 4-6 5, 7-13, 15, 16 10, 11 2-12, 16, 17 5-11, 14-16, 20-22 1, 4, 6, 11-15 1, 2 4, 6-10 1, 2, 3, 5-7, 10, 12, 14 5-10, 18 2-4, 6, 7, 12-14 1, 3 14-22	
Light covers broken/ missing	Agueda Johnson MS Daniel L Perez ES Inarajan MS JP Torres Alternative School Juan M Guerrero ES MU Lujan ES Maria Ulloa ES Merizo Martyrs Memorial ES Talofofo ES Vicente SA Benavente MS Wettengel ES	3-5, 7, 8, 11 4-7, 11 15, 16 2-4 11-17, 19 11, 14-16 1, 4, 8-10, 12, 17, 20, 23 1, 4, 6 2, 7, 12 4, 6-8, 10, 11 3-5, 10-12	Yes in some cases
Classroom interior paint too dark	FB Leon Gurrero MS Juan M Guerrero ES Simon Sanchez HS Southern HS	3-9, 12 11-17, 19 11, 12 2-6	No
Air Quality			
Weather seals needed on doors	Agana Heights ES	3, 9	No
Outside air intake needed for A/C	Agana Heights ES Captain HB Price ES Chief Brodie ES George Washington HS JQ San Miguel ES Jose LG Rios ES LP Untalan MS LBJ ES Simon Sanchez HS	3, 9 14 6 8, 14, 16 2, 4, 6, 7, 9, 12 5 7, 8, 10, 13, 29 7 11, 12	Yes
Unclean air diffusers	Agana Heights ES Agueda Johnson MS CL Taiatano ES Captain HB Price ES	2, 5, 6, 7, 12, 13 1, 3-5, 7, 8, 12-14 7, 9-13, 17-19 1, 2, 4, 6-9, 14	Yes in some cases

IEQ Issue	School	Buildings	Covered in DM
	BP Carbullido ES	1, 4, 5, 8, 9, 12, 13, 15	
	Daniel L Perez ES	4-8, 10, 12	
	FB Leon Gurrero MS	7-9, 12	
	Finegayan ES	2-5, 11	
	George Washington HS	1, 3-6, 8, 9, 10, 17-21, 24-26	
	Inarajan MS	7, 8, 12, 13	
	Jose LG Rios ES	6, 8	
	LBJ ES	3, 4	
	MU Lujan ES	5-11, 13-16, 20-23	
	Merizo Martyrs Memorial ES	1, 4, 6, 11-15	
	Pedro C Lujan ES	1, 2, 3, 5-7, 10, 12, 14	
	Simon Sanchez HS	5-8	
	Talofofo ES	3, 4, 6	
	Tamuning ES	1, 3	
	Wettengel ES	3-5, 10-12	
Remove mold/ mildew	Agana Heights ES	6, 7	Yes in some cases
	Agueda Johnson MS	11	
	Astumbo ES	12-14	
	Captain HB Price ES	1, 2, 4, 6, 13 (room G10)	
	BP Carbullido ES	8, 15	
	Daniel L Perez ES	11	
	FB Leon Gurrero MS	3-9, 12	
	Finegayan ES	6-10, 14-17, 22-27	
	George Washington HS	1, 9, 10, 14, 16-21, 24-26	
	Inarajan MS	7, 15	
	JP Torres Alternative School	2-4	
	Juan M Guerrero ES	13-17	
	MA Sablan ES	3-5, 7-11, 16, 18	
	Machananao ES	2-7	
	Maria Ulloa ES	1, 4, 8-13, 17, 20, 22, 23	
	Oceanview MS	4-10, 12-22	
	Ordot-Chalan Pago ES	4, 6-10	
	Pedro C Lujan ES	1, 5-7, 10, 12, 14	
	Simon Sanchez HS	1, 5-7, 18	
	Southern HS	4-6, 8-10	
	Talofofo ES	2-4, 6, 7, 12-14	
	Vicente SA Benavente MS	4, 6-8, 10, 11, 14-22	
	Wettengel ES	3-13	
Mildewed/ broken Acoustic ceiling panels	Captain HB Price ES	9	Yes
	Inarajan ES	4-6	
	Inarajan MS	5, 9-11	
	Juan M Guerrero ES	13-17	
	LBJ ES	7	
	MA Sablan ES	14, 15	
	MU Lujan ES	11, 14-16	
	Ordot-Chalan Pago ES	1	

IEQ Issue	School	Buildings	Covered in DM
	Pedro C Lujan ES Simon Sanchez HS Tamuning ES	10 9, 10, 18 1, 3	
Odors in classrooms	Agana Heights ES Daniel L Perez ES MU Lujan ES Merizo Martyrs Memorial ES Simon Sanchez HS Talofofo ES	2 12 5-10 5 1 3, 4, 6	Yes in some cases
Classroom has leak/ drainage issue	BP Carbullido ES Tamuning ES Wettengel ES	15 1, 3 3-5, 10-12	Yes
Old unused A/C units left in place	Agana Heights ES FB Leon Gurrero MS George Washington HS Tamuning ES	4 3-9, 12 16 1, 3	Yes in some cases
A/C equipment too noisy	Chief Brodie ES MU Lujan ES Pedro C Lujan ES Southern HS	7 11, 14-16 14 2-6	No
Interior/ exterior wall partitions or insulation needed	Captain HB Price ES BP Carbullido ES George Washington HS Harry S Truman ES JP Torres Alternative School JQ San Miguel ES Jose LG Rios ES Juan M Guerrero ES LBJ ES MA Sablan ES MU Lujan ES Maria Ulloa ES Oceanview MS Pedro C Lujan ES Upi ES	9 9 16, 25 (Rooms D101/102) 8, 12 4 2, 4, 6, 7, 9, 12 6 2, 4, 5, 9, 19 8, 16, 17 19-23 20-22 8-10, 20, 22, 23 5, 6 3, 10 14-16	No
Gasketed windows or doors needed	Captain HB Price ES Daniel L Perez ES	6, 9 4-7	Yes in some cases
Pests			
Pests should be exterminated	Astumbo ES Ordot-Chalan Pago ES Wettengel ES	12-14 4, 6-10 3-5, 10-12	No

USVI – IEQ Issues Identified in Phase II and Locations

IEQ Issue	School	Building	Covered in DM
Thermal Comfort			**Yes**
Inoperable/ broken/ inadequate windows	Adelita Cancryn JHS	Buildings 2, 3, 4, 6, 7, 12, 13, 15, 16, 17, 18	Yes in some cases
	AleXander Henderson ES	Buildings 1, 3	
	Alfredo Andrews ES	Buildings 1, 3	
	Arthur Richards JHS	Buildings 1, 2, 3, 7	
	Bertha C. Boschulte MS	Buildings 2-5, 7, 8, 10, 11, 13	
	Central High School	Buildings 5-11, 13, 14- 19, 21	
	Charles Emmanuel ES	Buildings 2, 4, 5-7	
	Charlotte Amalie HS	Buildings 1, 2, 3, 6-12, 15-17 19, 21, 22, 25, 26, 28-30, 32	
	Claude O. Markoe ES	Buildings 3-5, 6, 8, 9, 13	
	E. Benjamin Oliver ES	Buildings 2-16	
	Edith L. Williams Academy	Buildings 1, 2, 4, 13	
	Educational Complex HS	Buildings 1, 2, 3	
	Elena Christian JHS	Buildings 2, 4, 5	
	Eulalie Rivera ES	Building 3-5, 7, 8, 10, 11	
	Evelyn Williams ES	Buildings 3-7, 9-13	
	Gladys A. Abraham ES	Buildings 1, 2-9	
	Guy Benjamin ES	Buildings 1, 3, 4	
	Ivanna Eudora Kean HS	Buildings 4, 5-7, 8-24	
	Jane E. Tuitt ES	Buildings 3, 5, 6	
	John Woodson JHS	Buildings 3-5	
	Joseph Gomez ES	Buildings 4, 5, 7, 10, 11	
	Joseph Sibilly ES	Buildings 1, 2, 4, 5, 9	
	Juanita Gardine ES	Buildings 1, 3-8, 10, 11, 18, 19	
	Julius Sprauve ES	Buildings 2, 4, 5, 7	
Missing/ inadequate Roof Insulation	Adelita Cancryn JHS	Buildings 2, 3, 7, 13, 15, 16, 17, 18	No
	Arthur Richards JHS	Building 7	
	Bertha C. Boschulte MS	Buildings 2-5, 7, 8, 10, 11, 13	
	Central High School	Buildings 5-11, 14- 19, 22	
	Charles Emmanuel ES	Buildings 2, 4, 5-7	
	Charlotte Amalie HS	Buildings 8-12, 19, 21, 22, 25	
	Claude O. Markoe ES	Buildings 10, 11, 13	
	E. Benjamin Oliver ES	Buildings 2-16	
	Edith L. Williams Academy	Buildings 1, 2, 4, 13	
	Educational CompleX HS	Buildings 1, 2	
	Eulalie Rivera ES	Building 3-5, 7, 8, 9-11	
	Guy Benjamin ES	Buildings 1, 3, 4	
	Jane E. Tuitt ES	Buildings 5, 6	
	Joseph Gomez ES	Buildings 4, 5, 10, 11	
	Joseph Sibilly ES	Buildings 1, 2, 4, 5, 9	
	Juanita Gardine ES	Buildings 1, 3-8, 10, 11, 18, 19	
	Julius Sprauve ES		

		Buildings 2, 4, 5	
Windows covered to keep in cooled air	Adelita Cancryn JHS Central High School Charlotte Amalie HS Educational CompleX HS Guy Benjamin ES Julius Sprauve ES	Buildings 2, 3, 4, 6, 7, 12, 13, 15, 16, 17, 18 Building 21 Buildings 8-12, 19, 21, 22, 25 Buildings 1, 2 Building 4 Buildings 2, 4, 5, 7	No
Ceiling fans not working/ missing/ inadequate	Adelita Cancryn JHS AleXander Henderson ES Alfredo Andrews ES Central High School Charles Emmanuel ES Charlotte Amalie HS Claude O. Markoe ES Educational CompleX HS Eulalie Rivera ES Evelyn Williams ES Guy Benjamin ES Jane E. Tuitt ES John Woodson JHS Joseph Gomez ES Joseph Sibilly ES Juanita Gardine ES Julius Sprauve ES	Buildings 2, 3, 4, 6, 7, 12, 13, 15, 16, 17, 18 Buildings 1, 3 Buildings 1, 3, 7 Buildings 5-11, 13, 14- 19, 22 Buildings 2, 4, 5, 7 Buildings 8-12, 19, 21, 22, 25, 26, 28-30, 32 Buildings 3-5, 6, 8, 9 Buildings 1, 2, 3 Building 3-5, 7, 8 Buildings 3-7, 9-13 Buildings 1 Buildings 3, 5, 6 Buildings 3-5 Buildings 4, 5, 7, 10, 11 Buildings 5 Buildings 1, 3-8, 10, 11, 18, 19 Buildings 2, 4, 5, 7	No
Inoperable/ malfunctioning/ inadequate A/C	AleXander Henderson ES Alfredo Andrews ES Arthur Richards JHS Charlotte Amalie HS Evelyn Williams ES Guy Benjamin ES John Woodson JHS	Buildings 1, 3 Buildings 1, 3 Buildings 1, 2, 3 Buildings 8-12, 19, 21, 22, 25 Buildings 3-7, 9-13 Building 5 Buildings 3-5	Yes
Building siting/ location prevents natural ventilation	Adelita Cancryn JHS	Buildings 2, 3, 7, 13, 16	No
Window tint needed	Arthur Richards JHS Charlotte Amalie HS	Buildings 1, 2, 3 Buildings 33, 34	No
Light Levels			
Interior or exterior window shades needed	Alfredo Andrews ES Arthur Richards JHS Central High School Charles Emmanuel ES Charlotte Amalie HS Claude O. Markoe ES E. Benjamin Oliver ES	Buildings 1, 3 Buildings 1, 2, 3, 7 Buildings 5-11, 13, 14- 19, 21 Building 6 Buildings 33, 34 Buildings 3-5, 6, 8, 9-11, 13 Buildings 2-16	No

	Edith L. Williams Academy	Buildings 1, 2, 4	
	Educational CompleX HS	Buildings 1, 2, 3	
	Elena Christian JHS	Buildings 2, 4, 5	
	Eulalie Rivera ES	Building 9-11	
	Evelyn Williams ES	Buildings 3-7, 9-13	
	Gladys A. Abraham ES	Buildings 1, 2-9	
	Guy Benjamin ES	Building 3, 4, 5	
	Ivanna Eudora Kean HS	Buildings 4, 5-7, 8-24	
	Jane E. Tuitt ES	Buildings 3, 5, 6	
	John Woodson JHS	Buildings 3-5	
	Joseph Gomez ES	Buildings 4, 5	
	Joseph Sibilly ES	Building 1, 2, 4, 9	
	Juanita Gardine ES	Buildings 1, 3-8, 10, 11, 18, 19	
	Julius Sprauve ES	Buildings 2, 4, 5, 7	
Differential Light controls needed	AleXander Henderson ES	Buildings 1, 3	No
	Alfredo Andrews ES	Buildings 1, 3	
	Central High School	Buildings 5-9, 14-16, 19, 21, 22	
	Charles Emmanuel ES	Buildings 2, 4, 5, 7	
	Claude O. Markoe ES	Buildings 3-5, 6, 8, 9	
	Educational CompleX HS	Buildings 2, 3	
	Eulalie Rivera ES	Building 9	
	Evelyn Williams ES	Buildings 3-7, 9-13	
	John Woodson JHS	Buildings 3-5	
	Julius Sprauve ES	Buildings 2, 4, 5	
Opaque louvers don't allow in natural light	Adelita Cancryn JHS	Buildings 2, 3, 4, 6, 7, 12, 13, 15, 16, 17, 18	No
	Arthur Richards JHS	Building 7	
	Bertha C. Boschulte MS	Buildings 2-5, 7, 8, 10, 11, 13	
	Central High School	Buildings 5-11, 14- 19, 21	
	Charles Emmanuel ES	Buildings 2, 4, 5, 7	
	Charlotte Amalie HS	Buildings 1, 2, 3, 6-12, 15-17, 19, 21, 22, 25, 26, 28-30, 32	
	Edith L. Williams Academy	Buildings 1, 4, 13	
	Educational CompleX HS	Building 2	
	Elena Christian JHS	Buildings 2, 4, 5	
	Gladys A. Abraham ES	Buildings 1	
	Ivanna Eudora Kean HS	Buildings 6, 7	
	Joseph Sibilly ES	Buildings 5	
	Joseph Sibilly ES	Building 2, 4, 9	
Windows covered with boards/ paper	Adelita Cancryn JHS	Buildings 2, 3, 4, 6, 7, 12, 13, 15, 16, 17, 18	No
	AleXander Henderson ES	Buildings 1, 3	
	Alfredo Andrews ES	Buildings 1, 3	
	Central High School	Building 13	
	Jane E. Tuitt ES	Buildings 3, 5, 6	
	John Woodson JHS	Buildings 3-5	
	Julius Sprauve ES	Buildings 2, 4, 5	
Inadequate/ inoperable	Arthur Richards JHS	Building 7	Yes in some cases

light fixtures	Edith L. Williams Academy Educational CompleX HS Gladys A. Abraham ES Joseph Gomez ES Julius Sprauve ES	Buildings 1, 4, 13 Building 2 Buildings 2-9 Buildings 4, 5 Buildings 2, 4, 5, 7	
Light lamping not uniform/ inappropriate	Joseph Sibilly ES	Building 13	No
Light covers broken/ missing	Claude O. Markoe ES Edith L. Williams Academy Educational CompleX HS Joseph Sibilly ES	Buildings 3-5, 6, 8, 9 Buildings 1, 2, 4 Building 2 Building 4	Yes in some cases
Classroom interior paint too dark	Central High School Charles Emmanuel ES Claude O. Markoe ES Eulalie Rivera ES Evelyn Williams ES Guy Benjamin ES	Buildings 5-7, 13, 14-16, 19 Buildings 2, 4, 5, 7 Buildings 3-5, 6, 8, 9 Buildings 3-5, 7, 8, 10, 11 Buildings 3-7, 9-13 Building 3	No
Air Quality			
Unclean Air diffusers	Charlotte Amalie HS Edith L. Williams Academy Elena Christian JHS Joseph Sibilly ES Julius Sprauve ES	Buildings 26, 28-30, 32-34 Buildings 1, 2, 4, 13 Buildings 2, 4, 5 Building 2, 4, 9 Buildings 2, 4, 5, 7	Yes in some cases
Remove mold/ mildew	Edith L. Williams Academy Elena Christian JHS Guy Benjamin ES Ivanna Eudora Kean HS Joseph Gomez ES Juanita Gardine ES	Buildings 1, 2, 4, 13 Buildings 2, 4, 5 Building 4 Buildings 4, 5, 8-24 Buildings 4, 5, 7 Buildings 1, 3-8, 10, 11, 18, 19	Yes in some cases
Mildewed/ broken Acoustic ceiling panels	Alfredo Andrews ES Jane E. Tuitt ES	Buildings 1, 3 Buildings 3, 5, 6	Yes
Odors in classrooms	Arthur Richards JHS Charlotte Amalie HS Claude O. Markoe ES Edith L. Williams Academy Joseph Sibilly ES Juanita Gardine ES	Buildings 1, 2, 3 Buildings 26, 28-30, 32 Buildings 3-5, 6, 8, 9 Buildings 1, 4 Building 1 Buildings 3-8, 10, 11	Yes in some cases
Classroom has leak/ drainage issue	AleXander Henderson ES Alfredo Andrews ES Arthur Richards JHS Bertha C. Boschulte MS Charlotte Amalie HS E. Benjamin Oliver ES Elena Christian JHS Evelyn Williams ES Gladys A. Abraham ES	Buildings 1, 3 Buildings 1, 3 Buildings 1, 2, 3 Buildings 2-5, 7, 8, 10, 11, 13 Buildings 6-12, 15-17, 19, 21, 22, 25, 26, 28-30, 32 Buildings 2-16 Buildings 2, 4, 5 Buildings 3-7, 9-13 Buildings 2-9	Yes

Old unused A/C units left in place	Charlotte Amalie HS Gladys A. Abraham ES	Buildings 26, 28-30, 32 Buildings 2-9	Yes in some cases
Unclean/ garbage/ dusty around classroom	Bertha C. Boschulte MS Charlotte Amalie HS E. Benjamin Oliver ES Elena Christian JHS Gladys A. Abraham ES Ivanna Eudora Kean HS Joseph Gomez ES Julius Sprauve ES	Buildings 2-5, 7, 8, 10, 11, 13 Buildings 8-12, 19, 21, 22, 25 Buildings 2-16 Buildings 2, 4, 5 Buildings 2-9 Building 6, 7 Buildings 4, 5, 7, 10, 11 Buildings 2, 4, 5	No
Inadequate/ lacking Window screens	Charlotte Amalie HS	Buildings 8-12, 19, 21, 22, 25	Yes in some cases
Vehicles parking/ driving next to classrooms	Adelita Cancryn JHS Charlotte Amalie HS Ivanna Eudora Kean HS Jane E. Tuitt ES	Building 16, 17, 18 Buildings 1, 2, 3, 6-12, 15-17, 19, 21, 22, 25, 26, 28-30, 32-34 Buildings 4, 5-7, 8-24 Buildings 3, 5, 6	No
Noise			
A/C equipment too noisy	Eulalie Rivera ES	Buildings 10, 11	No
Interior/ exterior wall insulation needed	Adelita Cancryn JHS Arthur Richards JHS Edith L. Williams Academy Elena Christian JHS Gladys A. Abraham ES	Building 16, 17, 18 Buildings 1, 2, 3 Building 2 Buildings 2, 4, 5 Buildings 1	No
Pests			
Pests should be exterminated	Charlotte Amalie HS Claude O. Markoe ES	Buildings 6-12, 15-17, 19, 21, 22, 25, 26, 28-30, 32 Building 13	No