Design Guidelines

An Introduction

The Educational Facility Master Plan was carefully crafted to reflect the vision of the Virgin Islands Department of Education. It aligns the requirements to maximize student and teacher engagement with the physical attributes of all schools and support buildings within the district.

In order to ensure the proper implementation of the vision crafted in the Educational Facility Master Plan, we have included design guidelines.

These guidelines are not prescriptive technical specifications, but rather are performance-based standards that align both space curricula factors, which correlate with improved engagement of all stakeholders, with the physical attributes of individual buildings that maximize the sustainable and resilient strategies identified as priorities during the master planning process.

Implementing the recommendations of the VIDE Educational Facility Master Plan provides a tremendous opportunity to renovate, modernize/expand and/or build new school facilities with a long view to the future and an understanding that these school facilities will be:

- **Expected to provide for space curricula alignment* while meeting the ever-changing needs of teaching, learning and technology.**
- **Subjected to natural hazard events such as high winds, flooding, and earthquakes.**
- **Subjected to continuous effects of a tropical island climate including sun radiation, high humidity, high levels of rain fall and sea-salted air.**

All modernizations/expansions and new builds should be brought into compliance with current IBC cove & other industry standards. See industry standards at the end of this section.

*The space curricula alignment indicators are pictured at left.
For more information on space curricula alignment, reference the *Data Driven Process* section of the Educational Facility Master Plan.

The Six Shearing Layers of Change

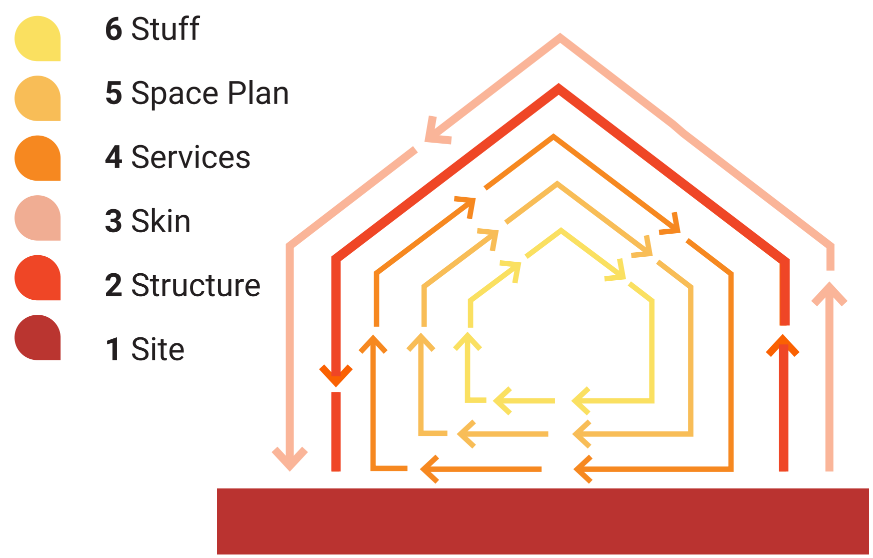
The design recommendations and strategies are being proposed within the context of the life span and relative ability of components of a building to change over time – this is known as the Six Shearing Layers of Change[1] defined as site, structure, skin, services, space plan and stuff.

“Our basic argument is that there isn’t such a thing as a building.

A building properly conceived is several layers of built components...

Thinking about buildings in this time-laden way is very practical. As a designer you avoid such classic mistakes as solving a five-minute problem with a fifty-year solution, or vice versa. It legitimizes the existence of different design skills - architects, service engineers, space planners, interior designers - all with their different agendas defined by this time scale. It means you invent building forms which are very adaptive.”[2]

Frank Duffy, British architect



[1]Original Idea: Architect Frank Duffy, Further Definition: Stewart Brand How Buildings Learn
[2]*Shearing Layers*
https://shearinglayers.com/focus/the-very-next-step/

Design Guidelines

Introduction The Six Shearing Layers of Change

The site, or location is the layer that typically changes the least over time. A site and its surrounding context can exist for generations beyond the life of a building.

The structure, once built, can be difficult and expensive to modify, and it should be designed to last for generations. The structure is also the layer that must literally stand up against natural hazards like earthquakes and tsunamis. It is important to design the structure to the appropriate performance criteria, which may exceed basic building code, if it is expected that the school will serve as a shelter or to be operational as a school in the aftermath of a natural hazard event. However, the design of the structure should also allow for future change of systems and program spaces within it.

The skin, or exterior materials and wall systems that protect from sun, wind and rain, are the next layer that lasts the longest and is changed the least. Some materials like brick or stone can last as long as the structure when properly maintained, while other materials like windows will often need to be replaced in 30-50 years. It is important that this layer can withstand the tropical climate as well as passively mitigate the effects of that climate on the interior spaces and occupants.

1 Site … **6** Stuff

The services layer typically has components that need on-going attention (air filter changes; clean coils; lubricate fans or pumps, etc.) as well as replacement in 15-25 years. This layer should be designed to be durable and consume the least amount of resources (energy, materials, time) while providing occupant health and comfort.

Canyon View High School | Waddell, Arizona

The space plan, or interior walls that create the rooms are historically not flexible within a school and are not changed at all over the life span of a building. However, modern schools today need to be able to adapt and change in response to the curriculum, styles of learning and to encourage collaborations and connections. There should be consideration for change that can happen daily as well as change that may happen in 10-15 years as pedagogy or the student population changes. Again, special attention should be paid in selection of materials to ensure that they will be durable in the tropical climate, and allow for connections to the outdoors.

The last layer is **the stuff** that goes into the building. This layer includes furniture, equipment and technology as well as consumable goods and supplies, so they will change daily, but also includes items that are expected to last five or more years. These items should be selected to be flexible and durable. Special consideration should be given to the materials used both in terms of resisting corrosion, healthy materials, as well as in terms of the space plan and how they may be protected or stored in anticipation of a hurricane.

The following design guidelines synthesize space curricula alignment criteria with the sustainable high-performance criteria in support of best educational outcomes, best use of resources and best return on investment. Unless otherwise noted, guidelines apply to both new building and modernizations.

Right *Pathfinder Kindergarten Center I Everett, Washington*

Design Guidelines

A Community Resource: Promoting Equity & Inclusion

All the VIDE schools should be designed to be inclusive centers for community: students, staff, parents, neighbors and businesses should feel welcome and take pride in their schools.

Provision of special spaces or classrooms that support specific curriculum offerings such as innovative learning, CTE, art, music, theater and sports should also be able to support public community involvement and functions. High levels of parent and community involvement are major contributors to school success.

Site

The locations that are selected for renovation/modernization of existing buildings should be equitably accessible to the USVI community in the following ways:

Distributed so that neighborhoods and communities on each of the three islands have access to quality education and so that transportation needs for students are minimized.

Located on the site so that traffic patterns in and around the site are safe and accessible for both vehicles and pedestrians; meeting Americans with Disabilities Act (ADA) 2010 ADA Standards for Accessible Design and incorporating principles of Universal Design.[3] Special consideration should be taken when the sites have a lot of grade change to make entrances and outdoor programs accessible. (See also Whole Building Design Guide's Beyond Accessibility to Universal Design.)

Zoned to allow community access separate from academic access both during school hours and after.

Structure/Skin/Services

Designs should project a positive civic image that conveys the importance of education within the community, invokes community pride and incorporates vernacular architectural principles appropriate to their site and context to create schools that are uniquely of the Virgin Islands.

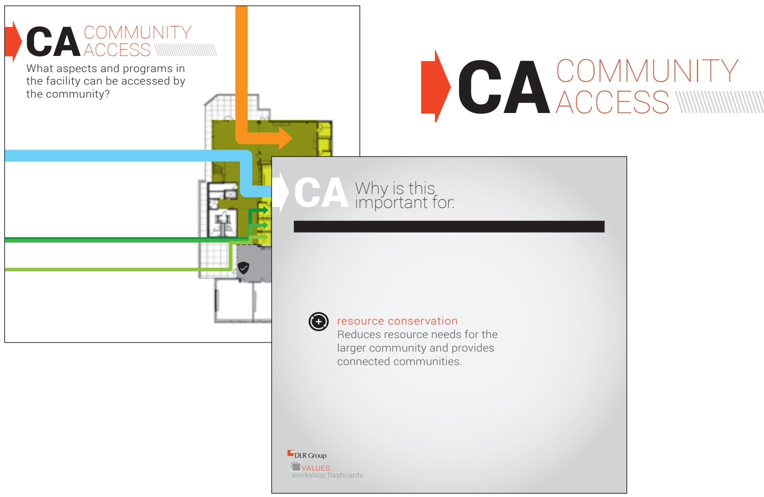
Note: This should not be interpreted as needing to recreate or copy historical island architecture.

Buildings must meet Americans with Disabilities Act (ADA) 2010 ADA Standards for Accessible Design and incorporate principles of Universal Design so that all floors and spaces can be accessed and used effectively by all types of people and so that systems (both passive & active) can be controlled by users in an intuitive way.

Systems (security & MEP/FP) design and distribution should be zoned to allow for different areas of a building to be used independently beyond the school day.

MEP: Mechanical, electrical, plumbing systems
FP: Fire protection systems

[3] *Principles of Universal Design*
https://www.access-board.gov/guidelines-and-standards/communications-and-it/26-255-guidelines/825-principles-of-universal-design



Top *Community access VALUES card*
Below *Sato Elementary School I Portland, Oregon*

Space Plan & Stuff

The plan should be zoned for layers of use and security – **public** (entrance lobbies, atrium, courtyard and some outdoor learning areas), **semi-public** (main office reception, auditorium, cafeteria, gyms, specialty classrooms, CTE businesses, etc.), **semi-private** (teaching and learning spaces) & **private** (offices, teacher workrooms). Modernizations will also need intervention/modification to the plans to ensure that zones of security are created. Overall adjacencies for both new and modernization/expansion of existing facilities have been provided as part of the advancement opportunities section of the Educational Facility Master Plan to serve as a starting place for the implementation of all of these projects.

Schools can play an important role in the community by providing a safe haven during and after storm events – accommodate space in new buildings that are to be designated as shelters for the community.

> FEMA 424 Design Guide for School Safety Against Earthquakes, Floods, and High Winds; FEMA 453 Design Guidance for Shelters and Safe Rooms.

Special spaces or classrooms that support specific curriculum offerings such as innovative learning, CTE, art, music, theater and sports should be planned to allow for after school programs, public and community use.

Design Guidelines

Stimulating Architecture

Architecture, both the exterior and interior forms/spaces, can have a profound effect on people's mood, emotions and perception. A school should promote curiosity, reflection, inspiration, discovery, creativity and joy. For this to be possible for people with diverse backgrounds, personalities, learning styles and challenges, a variety of spaces should be provided, both large and small to promote teaching, learning and building community. Primarily size, shape, scale and feel of individual learning spaces can support and enable learning and teaching. The total area and aspect ratio impact the adequacy of a learning space.

Structure/Skin

Utilize the building shape and form to create a variety of outdoor spaces that can serve for large, medium and small group gathering, learning and play space. Exterior materials and colors should be selected to be universally durable but light in color and appropriate for the Virgin Islands environment.

Space Plan & Stuff

Learning spaces should be welcoming and scaled appropriately to the age and number of the students as well as the activities.

Utilize activities-based programming that allows for multiple activities throughout the day, ranging from small- to medium- and large-group learning, to make the most efficient use of square footage. Remember the most expensive square foot of space is the one never used.

Furniture allows for a more student-centric focus on how each individual student can best be engaged. We all concentrate in different ways. Spaces, furniture and affordances should also meet the needs of people with physical, mental/emotional and learning challenges. Often this is best accomplished through variety of learning settings (big/little; quiet/active, etc.) and choices for furniture. Reference the Furniture Specifications that were developed in the Educational Facility Master Plan Appendix.

Materials and colors should be selected to be universally durable but allowed to promote focus and calm in some spaces and action and joy in others. Standard and accent palettes have been developed as part of the overall Educational Facility Master Plan and can be reviewed in the advancement opportunities section.

Left *Canyon View High School | Waddell, Arizona*

Top *Pathfinder Kindergarten Center | Everett, Washington*

Bottom *Wainwright Intermediate School | Tacoma, Washington*

Top *Kearney Middle School | Kearney, Missouri*

Bottom *Kodiak High School | Kodiak, Alaska*

Safe and Secure Supervision and Security

The extent to which physical configurations help or hinder student instruction and building operation in both typical and emergency situations needs to be carefully considered. This solution includes site buffers, secure zones, security fencing, sight lines, lighting, and obstructions in instructional spaces that make supervision difficult or impossible. Students and teachers feel safe anywhere in the building or on the grounds through:

Passive Strategies
- Opportunities for natural surveillance are optimized (Planning for transparency)
- The sense of community is reinforced
- Access is controlled

Active Strategies
- Security technology is used to enhance, rather than substitute for, the design features.

Reference the Safety and Security summary of the Visioning section of the Educational Facility Master Plan for further definition of the safety and security measures that should be implemented in the design and construction of individual projects.

Site

Visitor entrance is clearly identifiable – front office to have sight lines to the parking and entrance.

Space Plan

Front Office Reception accessible to visitors without entering the rest of school or front office. Vestibules large enough for visitors to interface with administration, teachers and students need to also be considered.

Discovery High School | Camas, Oregon

Offices (Administration/staff) and Teacher Planning spaces are distributed though the plan, especially at nodes where visual sight lines can be optimized to corridors, collaboration spaces and gathering spaces.

Outside learning areas should be evaluated for access. Some may be considered as more public in nature thereby being within the first ring of security. Other outdoor areas that are scaled for specific outdoor student activities should occur within the next level of secure perimeter.

Safe areas of refuge in fire stairs should be included for handicapped persons

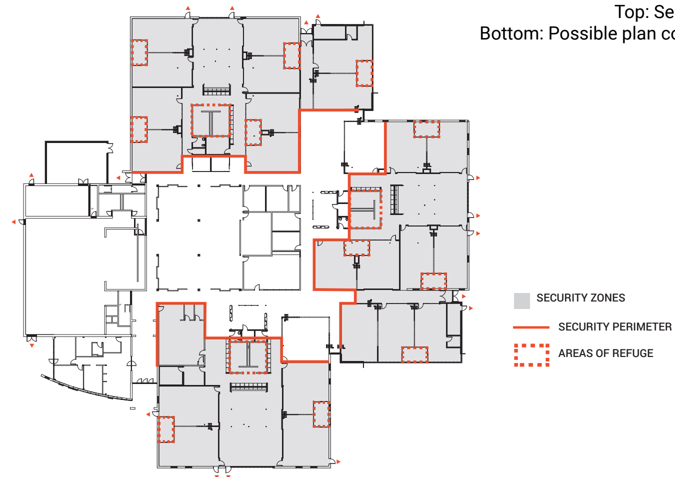
Card-key access at all exterior doors and stair doors at a minimum.

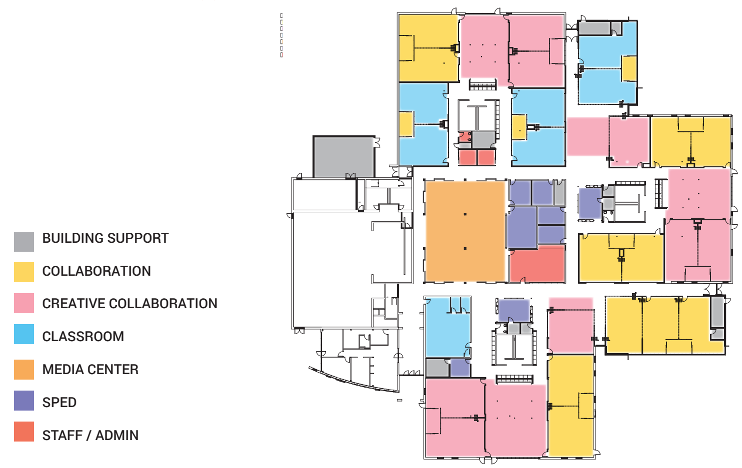
Provide security doors between wings (w/card-key access) to separate public community areas (cafeteria, gym, auditorium, library/media center) from academic classroom areas. These doors can be open during normal school hours and closed for after-school or community events. They will also make occupant management possible if part of building is used for shelter activities and part is still used for school activities.

Blue Valley Prairie Star Elementary School
Adaptable Renovation Scenario

Flexible Learning Environments:

Top: Security study
Bottom: Possible plan configuration





Stuff

Provide pull-down shades at all windows in learning spaces and offices for lock-down procedures, if part of security plan. Refer to security workshop within visioning section.

Design Guidelines

Innovative Learning Environments that Connect

Innovative Learning Environments should blur the lines between ages and abilities, to foster authentic learning and curricular exploration by expanding the definition of what a "place-based" community centric schools can be. Architecture needs to enable collaborative, creative, critical thinking that connects students to both theory and application through accessible, "hands on learning."

Services/Space Plan

Connect classrooms with maker spaces and labs.

Provide adjacencies that promote cross-disciplinary learning.

Provide open collaborations spaces at center of learning neighborhoods

Provide connections to covered outdoor learning from classrooms and open collaborations spaces.

Reference the program summaries and diagrams for learning suites that were developed for the range of ages and grades (PreK through 12). These age appropriate guidelines are included in the advancement opportunities section of the Educational Facility Master Plan.

Left *Meeker Elementary School | Greeley, Colorado*
Right *Ottawa High School | Ottawa, Kansas*

Flexibility

Presence of infrastructure, data distribution/storage, furnishings and equipment within classroom and laboratory settings should allow for multiple activities to occur.

Classrooms and break out spaces should be provided through the appropriate use of:

Services/Space Plan

- Establish plans with flexible partitions and moveable walls.
- Expand usability of corridors and open stairs– extended learning areas/small group areas/gathering spaces.
- Plan for change in the type of construction: daily change & change over time. Refer to space plan and stuff under equity and inclusion.
- Lighting and light control with multiple settings for different moods and activities.
- Technologies.

Reference the diagrams for learning suites that were developed for the range of ages and grades PreK-12. These age appropriate guidelines are included in the advancement opportunities section of the Educational Facility Master Plan. For additional examples of approaches to future facing designs, reference the benchmark and tours summary within the visioning section.

Top *Pathfinder Kindergarten Center | Everett, Washington*

Bottom *East Baton Rouge Lee High School I Baton Rouge, Louisiana*

Design Guidelines

Adaptability

Ability of common facilities (restrooms and toilets, cafeterias, libraries, and administrative areas) to meet the needs of the student population in the future as well as be able to adapt to changing educational delivery methods.

Site/Structure/Skin/Services:

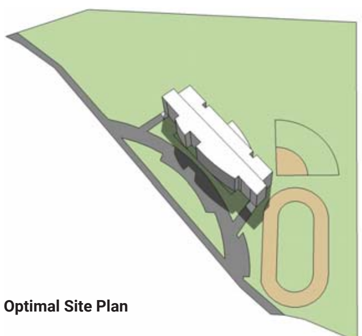
Design for expandability of building footprint and systems

Utilities/Infrastructure should be consolidated to minimize impact on future renovations

Space Plan & Stuff

A plan for adaptability and flexibility should be provided for every new and modernized school identifying different walls – 100-50 yr wall (structure); 30-20 yr wall; 10 yr wall; five yr wall; 24-hr wall – with clear instructions for moving such adaptable walls and furniture for equitable access.

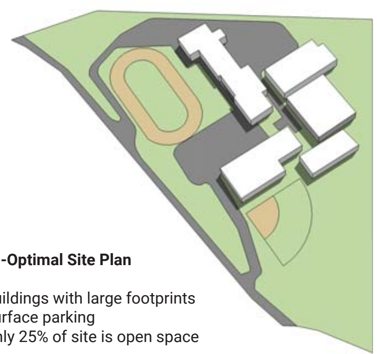
For existing building modernizations that have undersized classrooms arranged along single loaded outdoor corridors, adjustments/additions to include alternative multi-purpose and outdoor spaces for collaborative learning have been provided as part of the modernization/expansion program and plans.



Optimal Site Plan

Tall building & small footprint
Parking structure beneath building
50% of site is open space

Building Size & Growth



Non-Optimal Site Plan

Buildings with large footprints
Surface parking
Only 25% of site is open space

Buildings sized appropriately for their function and designed in a way to accommodate future growth are smart buildings. Communities with smart buildings require less infrastructure and preserve more open space, reducing costs and impact. Considering building size and growth:

Tall vs wide buildings
Parking sturctures vs parking lots
More open space vs more built space
Reconfigurable interiors
Restroom, HVAC, electrical & fire protection load
Expansion capability

At Panther Lake Elementary, rooms of consistent size, infrastructures, and technologies allow spaces to easily flex and respond to curricular needs that might change daily, weekly, annually, or over a projected 50 years.

For example, because every classroom-sized space features data and wireless infrastructures, has a sink, includes mobile furnishings and storage, and minimizes specific built-in amenities, the same room could potentially serve as a classroom, a staff lounge, or a computer lab.

Federal Way School District Panther Lake Elementary
Federal Way, Washington

Design Guidelines

Resilient and Efficient

Conserve resources and save money by providing high performance buildings and systems. The more operating costs that can be saved by having low utility costs, the more that can be spent on teachers, technology and supplies.

The more facilities can withstand a hazard event, the less money that will be spent on repairs and the more time that will be available for learning.

Additionally, attention should be paid to passive survivability strategies, so that the building could maintain habitable conditions even if systems are down in the immediate aftermath of a hazard event.

Site:

Massing & Orientation

Locate massing and orient learning and working spaces on site to avoid excessive solar exposure that contributes to heat gain and glare and to take best advantage of the trade winds – utilize site specific climate analysis and computational fluid dynamics to understand how to promote use of cooling breezes and the effects of topography and landscape.

Right *VI Wind Diagram*
Far Right *Lake Stickney Elementary School I Lynnwood, Washington*

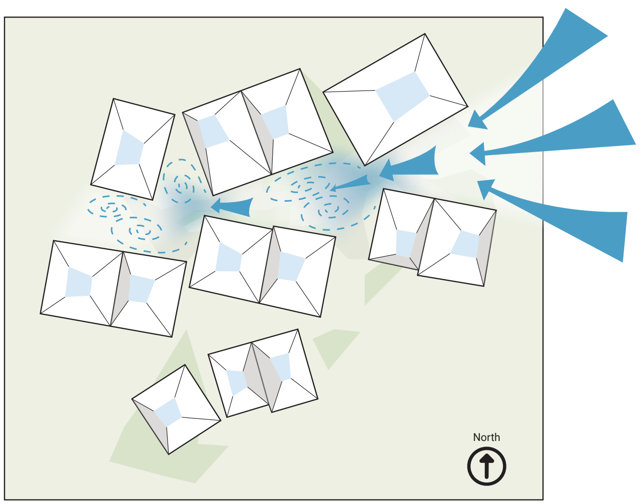
Storm Water Management

New or existing site: direct and/or collect rainwater so that it can be absorbed into the ground on site or used as part of grey water systems; no run-off to neighboring properties; utilize bioswales, etc.

Especially important on sloping site to direct it & slow it to prevent erosion: Cascading water management can be used for agriculture & landscape gardens.

Underground storm water storage – collect from driveways & impervious surfaces if natural elements (bioswales) over run. Collect onsite & release slowly after storm events to not burden surrounding neighborhood storm systems.

Evaluate permeable paving solutions.



Reduce Heat Island

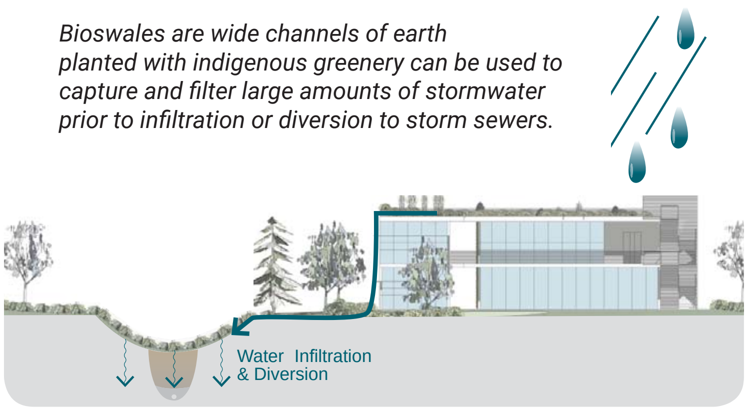
High albedo sidewalk/pavement or shading for parking & pavement areas.

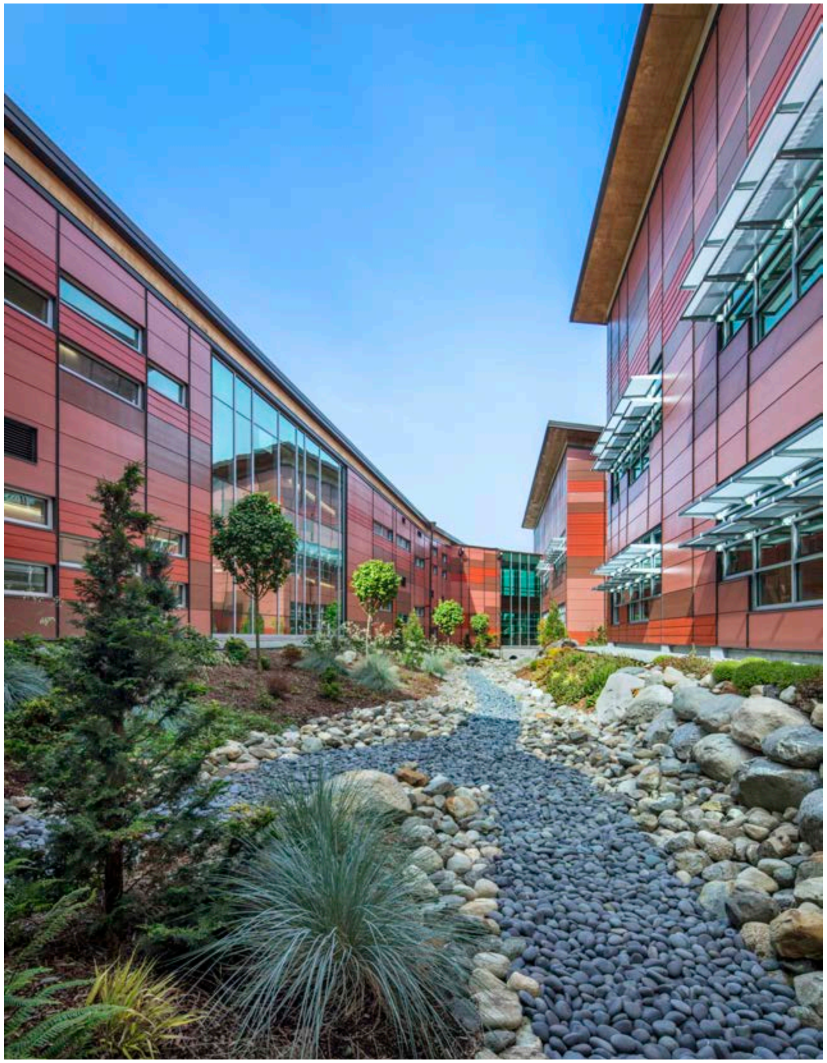
Landscaping

Utilize native species that do not require irrigation and minimal maintenance while at the same time providing best stormwater management in bioswales and shading of outdoor useable areas.

Limit size and height of trees, flag poles, utility poles near the building (FEMA 543 Design Guide for Flooding and High Winds) to minimize items that could fall onto the buildings during storm events.

Bioswales are wide channels of earth planted with indigenous greenery can be used to capture and filter large amounts of stormwater prior to infiltration or diversion to storm sewers.





Design Guidelines

Resilient and Efficient Continued

Structure

Existing Buildings – bring up to current seismic and wind code using the current IBC with all applicatble amendments.

Note: The current code at the time of the Educational Facility Master Plan is the 2018 IBC, but design teams are responsible for determining current code.

New Buildings – performance criteria to withstand Hurricanes & Earthquakes (FEMA 424 Design Guide for School Safety Against Earthquakes, Floods, and High Winds; FEMA 453 Design Guidance for Shelters and Safe Rooms) when used for shelter. Also refer to Florida's Division of Emergency Management 2018 Statewide Emergency Shelter Plan Appendix G –Guidance for Implementation of Public Shelter Design Criteria. Otherwise, use the current IBC code that is in force with addendums for wind.

Note: The current code at the time of the Educational Facility Master Plan is the 2018 IBC, but design teams are responsible for determining current code.

Protect structure from the elements of tropical climate – prevent corrosion. Water, relative humidity, air salinity & pollution, mold & mildew, insects & microbes, UV/solar radiation and soil conditions all contribute to corrosion.

Design teams need to understand:

How to protect existing?

How to protect new structures?

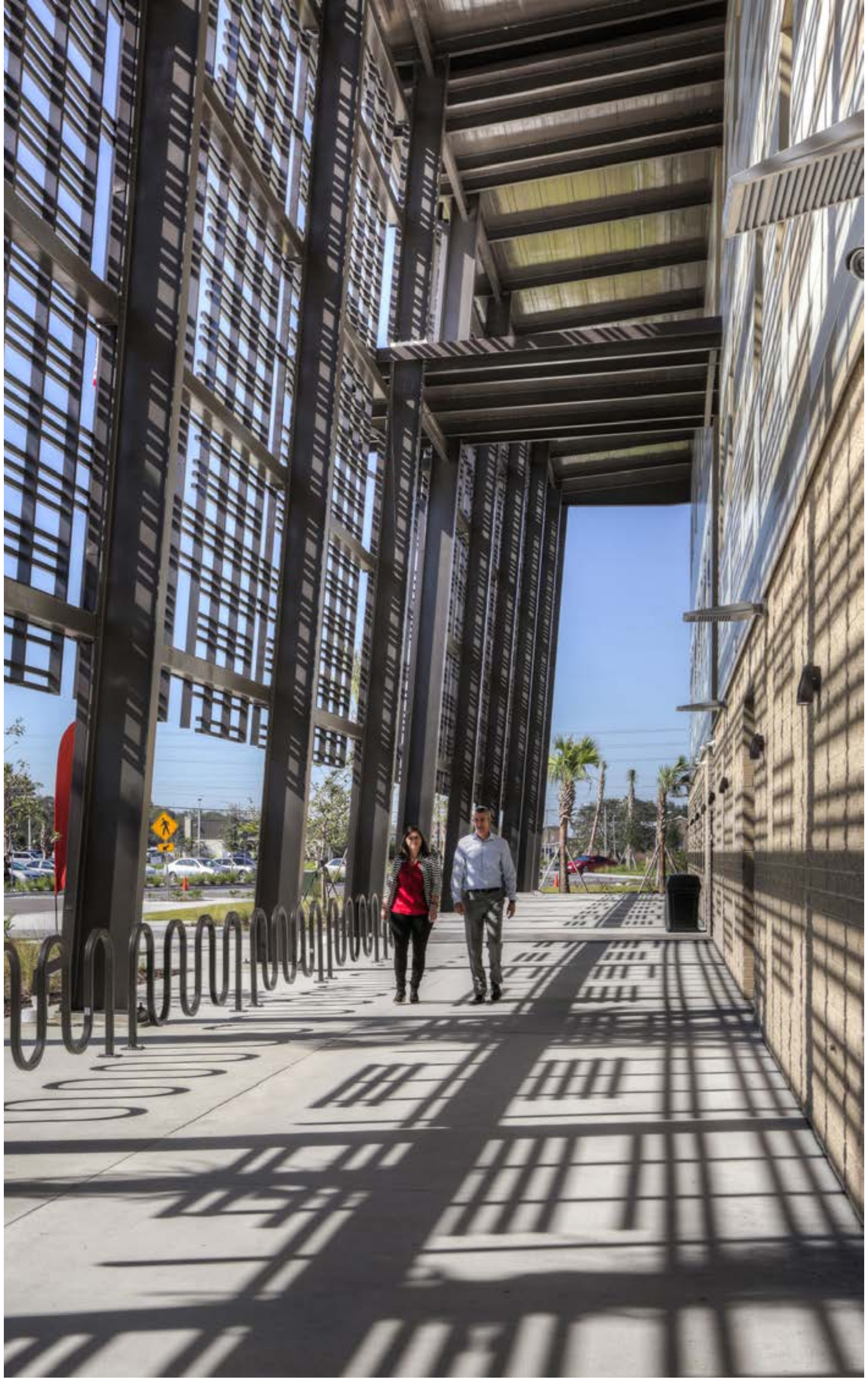
Provide infrastructure (electrical and structural) for renewables – shading structures w/PV; demountable Wind turbines, etc.

Plan structural modules (column, beam spacings) to be compatible with classroom sizes & flexibility;

Understand trades and construction available on islands (Note: re-opening of refinery may bring with it skilled steel workers); possibly consider precast & CMU as known trades on the Islands. Examine ROI if other precast or modular construction used for improved consistency, quality and on-site erection schedule.

Balance flexibility with capacity for shear – (shear walls, cross-bracing vs moment frame)

Below *Discovery PBL High School I Camas, Washington*
Right *Valencia College Poinciana Campus Building 01 I Kissimmee, Florida*



Skin

New buildings should have a glazing-to-wall ratio of +/- 25% glazing:75% wall as an aggregate total for all outside walls. Glazing includes punched windows, storefront and glass door systems, curtain wall & window wall systems. On modernization projects, design modifications should be evaluated for energy savings and daylight and glare improvements if the existing window/wall ratio is significantly varied from this recommended ratio, including if there is too much glazing or too little. Reduce heat island effect & heat gain from radiation on roofs in new buildings & modernizations.

High Solar Reflective Index (SRI) for roof surfaces (light colored) or green roofs

High Solar Reflective Index (SRI) for wall surfaces (light colored)

Reduce heat gain in spaces; provide ample daylight - Reducing heat gain has tremendous potential for reducing the size/cost of the cooling systems in addition to reducing energy use and making spaces more comfortable for learning.

Replace all existing windows & jalousie shutters with new windows in modernizations. Replace all exterior doors with new doors.

In both new buildings and modernizations provide quality operable high-performance windows: comply with Miami/ Dade County specifications for wind/impact resistance with a low solar heat gain coefficient; noncorrosive materials and screens. Provide proper flashing around all openings to eliminate water and air infiltration.

Design Guidelines

Resilient and Efficient Continued

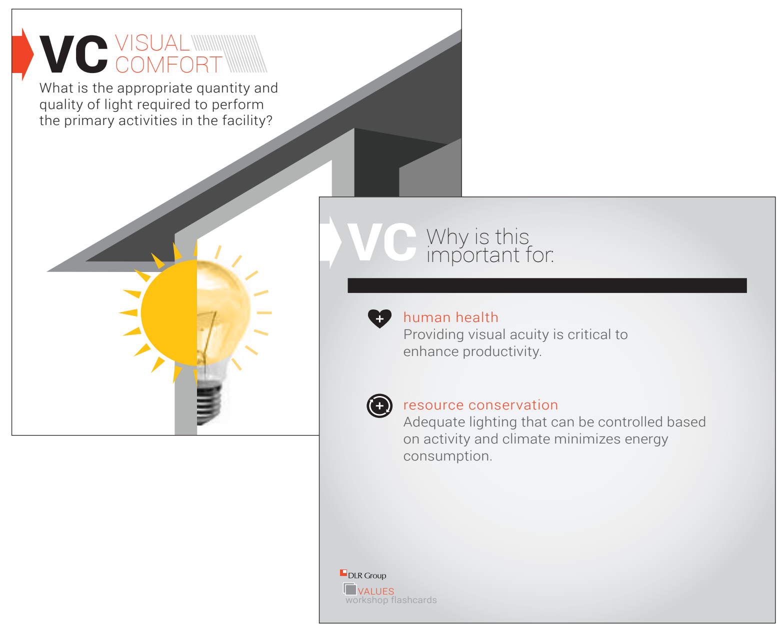
Provide operable low-E windows and transoms with a low Solar Heat Gain Coefficient of .25 or less. Skylights should have a SHGC of .27 or less. Maximum Window U-value = .67 Btu/(hr)(ft²)(°F); preferred U-value = .57 Btu/(hr)(ft²)(°F) or less.

Shading and overhangs for windows – design team should utilize performance analysis and ROI analysis to determine where sunshades and light shelves will be beneficial, especially on south, east & west facades. Performance analysis should be used during design of both new buildings and modernizations to optimize daylight autonomy within all teaching and learning spaces while minimizing heat gain and glare. Explore potential for adaptable shading that can also be used for protection during storms, such as perforated louvers or shutters. Sunshades & light shelves should be added to replacement windows in modernizations. Anchors should be able to withstand hurricane force winds & resist corrosion.

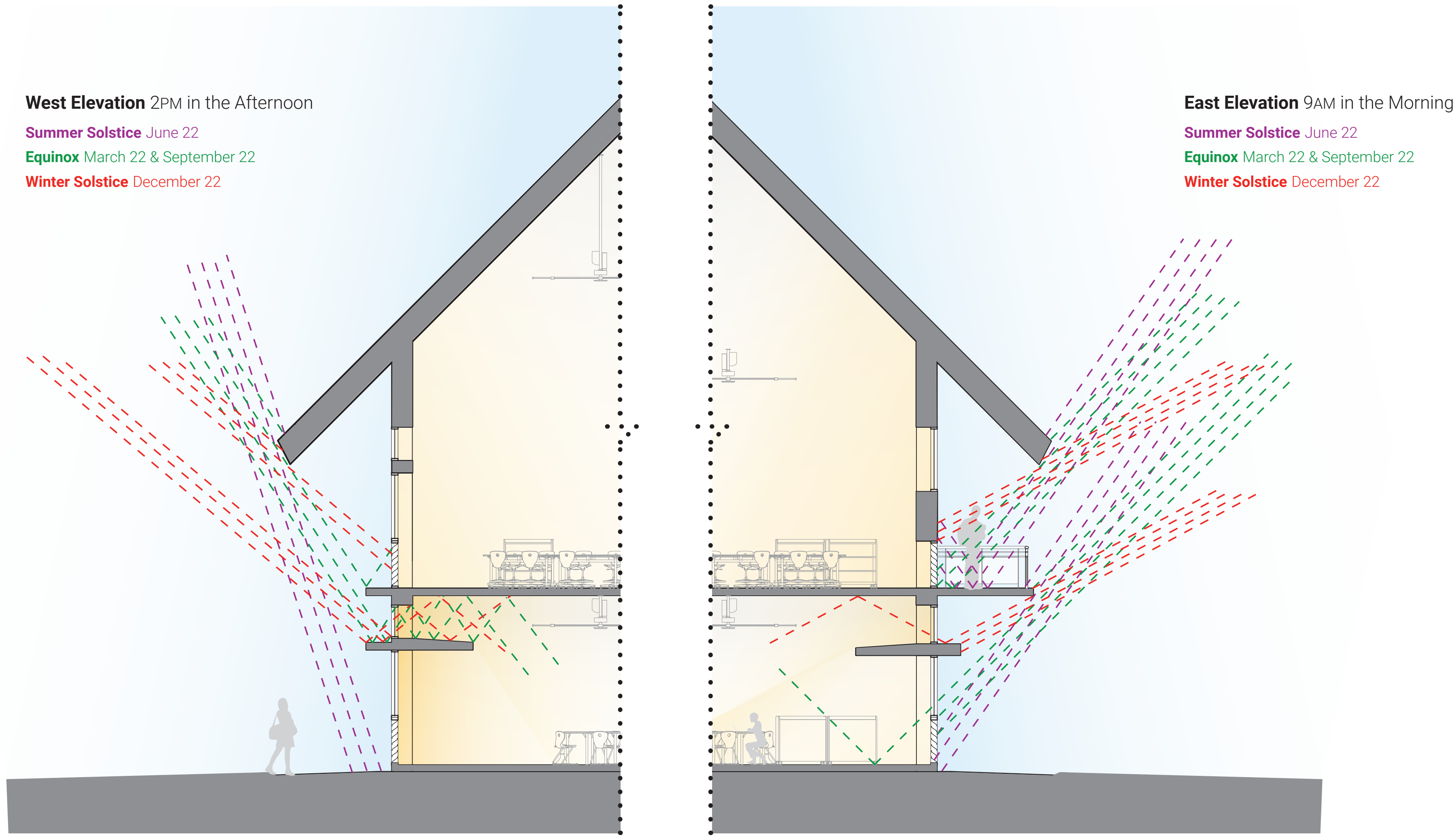
Shading of open corridors, gathering areas & outdoor classrooms; also add roof/shading structures in modernizations to increase useable outdoor space if none exists and to create more learning space to augment undersized classrooms that can't be expanded due to structural constraints.

PV's can be used as shading devices.

Use clerestory &/or solar tubes for increased daylight at interior spaces: improve light quality/save need for artificial lights; can also increase usability of spaces when power/lights are out.



Right *Visual comfort VALUES card*
Far Right *USVI Sunshade Wall Section Diagram*


West Elevation 2PM in the Afternoon
Summer Solstice June 22
Equinox March 22 & September 22
Winter Solstice December 22
East Elevation 9AM in the Morning
Summer Solstice June 22
Equinox March 22 & September 22
Winter Solstice December 22

Design Guidelines

Resilient and Efficient Continued

Water Management

Consider blue roofs (roof ponds) for new construction. Adequately plan for structural capacities.

Create roof overhangs to keep rain water off of walls. Provide roof drains or downspouts.

Utilize porches (colonnades) and balconies to keep water away from doors; utilize ADA acceptable slopes to shed water from walking surfaces.

Utilize flashing, drip-edge details, sloped window sills/thresholds and appropriately sloped grading to keep water moving out and away from building.

Walls/Roofs/Floors should be impact resistant; corrosion resistant; mold resistant and prevent heat gain, air infiltration and pest infiltration.

Prevent air, water and vapor from getting into wall/ceiling & floor cavities and through floor slabs (elevated and on-grade) – removing potential for moisture is the best preventative measure for reducing the potential for mold

Understand vapor permeability of wall materials so that moisture that may get into a cavity (leaks/condensation/humidity) can dry out; understand thermal properties and dew points of walls/ceilings/roofs/floor construction if inside air to be cooled (air conditioning); provide vapor barriers and insulation between cooled/conditions space and unconditioned space even at interior walls/ceilings/floors; avoid condensation in walls/ceilings/floors – utilize Wufi/Therm performance analysis; coordinate closely with HVAC systems

Provide continuous air, vapor, water barriers and insulation at exterior walls, roofs and underside of floors (when cantilevered or exposed to the outside/nonconditioned spaces) to manage dew points outside of building walls and structure. Where metal/mechanical fasteners are used (e.g. mechanically fastened roof membranes through roof decks) then ensure that they are not passing from cooled conditioned space to unconditioned space without understanding dew points and condensation potential to help prevent mold growth.

Provide radiant barrier in roof assemblies.

Provide effective, measured composite R-values for walls and roof assemblies to minimize heat gain and manage dew points:

Wall assemblies and exposed (raised/cantilevered) floor assemblies: R-17; Roof assemblies: R-30.

To eliminate pest, water and air infiltration, flash/seal around all openings where utilities enter through walls, roofs & slabs into enclosed spaces. Flashing/sealant at windows and doors openings keeps water and pests out.

Modernization Note: Verify and conduct analysis on existing walls/roofs and slabs in modernizations to determine actual construction and performance. Modify and add insulation and air/water/vapor barriers as required according to the performance analysis (Wufi/Therm) so that water does not get into cavities and new cooling and ventilation systems will not cause condensation inside of cavities and spaces. Floor slabs can also have condensation accumulate on them if there is no vapor barrier beneath the slab and spaces are cooled. Coordinate closely with HVAC systems.

Utilize natural ventilation and connection to outdoors when possible while meeting comfort criteria

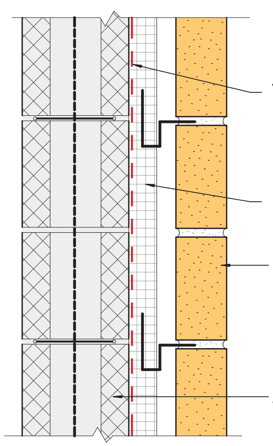
Create chimney effect and cross ventilation with operable windows – utilize computational fluid dynamics to understand air flow around buildings and through spaces

Understand acceptable permeability for all uses: establish permeability index for uses with client– how much openness; how much connection to outdoor spaces; how much environmental control needed?

Evaluate normal mode and storm mode

How can windows, shading devices, shutters be utilized – open during normal mode and closed in storm mode; how can building transform?

Wall Assembly Best Practices:



The dew point should occur outside of the vapor barrier.

Solar Ready for Net Zero: Photovoltaic Systems

All buildings shall be designed as net zero ready at a minimum. Buildings designed as areas of refuge shall be net zero and off-grid capable.

Provide locations to support enough future photovoltaic panels to achieve net zero energy. The structure shall be designed to support the additional weight.

Provide electrical provisions to support a future photovoltaic system sized to achieve net zero energy.

Provide electrical provisions to connect electrical storage (battery, fly wheel, etc.) to balance building demand and photovoltaic production due to zero feed in requirements for grid connectivity.

For critical facilities, provide photovoltaic and battery systems in base scope of design.

For more detailed guidelines and requirements, refer to the appendix.

Design Guidelines

Resilient and Efficient Continued

Services

Modernization Note: it is assumed that all Mechanical/Electrical/Plumbing (MEP) systems will be replaced unless they are less than 10 years old and can be proven to meet current standards including for both cooling and ventilation. It is assumed that all lighting will be upgraded to LED lighting. Electrical, fire alarm & fire protection services/distribution will likely need significant upgrades if not replacement unless they have been replaced in the last 10 years and can be proven to meet current standards. As a concept, approach HVAC systems, lighting and building controls in this order:

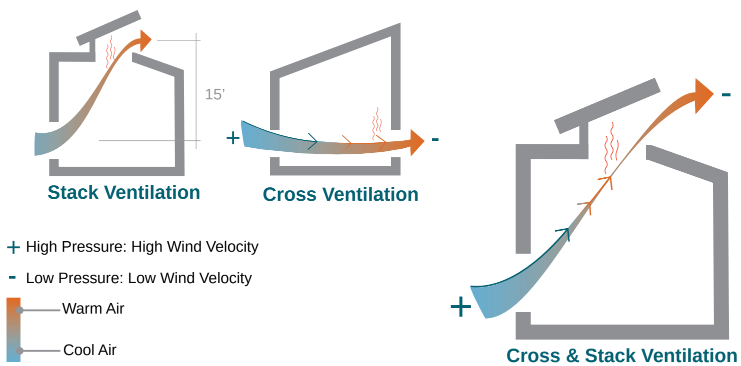
1. Passive systems first – no need for mechanical controls or means

2. Semi-active systems – can operate naturally with some support mechanically

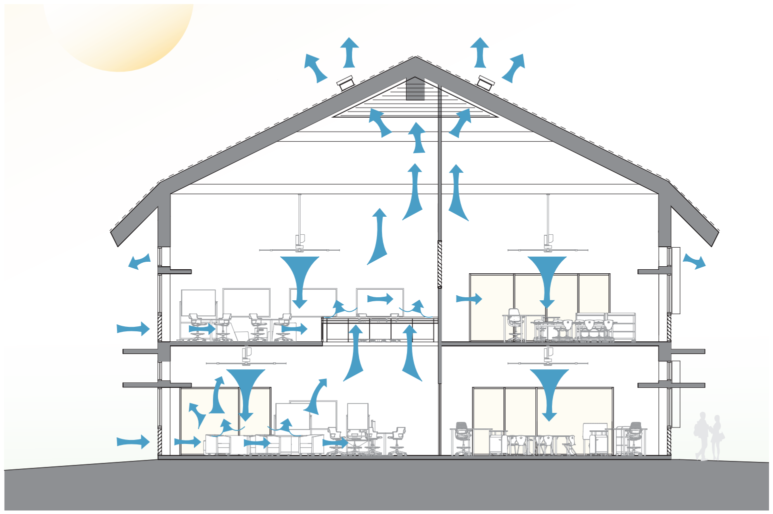
3. Active systems – completely rely on mechanical controls and means

Utilize **passive systems** as much as possible: rely on natural ventilation, shading and air movement (large fans) to maintain comfort in at least 25-30% of the time; also create comfort in outdoor spaces to make them useable – identify the level of permeability for each major program space.

Natural ventilation captures air from the exterior of the building and funnels it through a structure utilizing physics of natural air flow rather than a mechanical system.



VI Natural Ventilation Diagram



On a scale of totally permeable to not permeable (permeability index) determine which spaces can rely completely on passive systems; or have open mode and closed mode. Open/closed mode is different from normal/storm mode. Open/closed modes are based on weather conditions and program activity year-round during Normal mode. Storm mode is during extreme events.

Semi-active systems: introduce ventilation with dehumidification and air movement (fans) for at least 50% of the time; can be used in closed mode for spaces, can potentially be used in open mode for some conditions. Utilize climate analysis, computational fluid dynamics analysis and system performance analysis to understand conditions and maximize comfort without introducing additional cooling through active systems.

Energy efficient **active systems**: determine which spaces need air conditioning; design exterior and passive systems to be able to limit active system use to 30-35%;

Use dehumidification of fresh air for ventilation (dedicated outdoor air systems: DOAS) on CO2 monitors + radiant cooling (high temp to reduce possibility of condensation) or refrigerant as supplement.

Explore possible use of stored water (cistern or storm management) as heat exchanger;

Analyze use of earth tubes to pre-cool ventilation air, esp. on sites with grade changes leveraging the cost incurred for sub-structure.

Prioritize use of air-source over water-source heat rejection systems, with consideration of equipment location and anchoring based on wind and potential flooding.

VIDE Performance Modeling for Net Zero Energy

To achieve the VIDE's goal of 14-28 days of function off-grid after a hazard event, facilities need to be designed to be net zero energy ready.

In order to assess the viability of achieving net zero energy for the schools in the USVI, an energy model was constructed in IES VE 2019. The model used a current school building which closely matches the program for the USVI school buildings. The United States Virgin Islands are Climate Zone 1A meaning the targets for EUI before the application of renewable energy are around 21.

Strategies evaluated to achieve target EUI of 20-25 kBtu/SqFt/Yr

The building model started with ASHRAE 90.1-2016 (IECC 2018 equivalent) as the base case for inputs. From that base case, various energy conservation measures were applied, and the results assessed.

The variables studied include:

Window-to-wall ratio of 25% window/75% wall
Orientation of the building with long axis east-west
Increased cooling setpoint temperature and setback temperature
Reduction in lighting power density to 0.5 W/SF or less
Reduction in plug load density to 0.75 W/SF or less
Increased r-value in walls and roof (r-17 walls, r-30 roof)
Decreased u-value (.57) and Improved solar heat gain coefficient (.25) in windows
Decreased solar absorptance of roof and walls
Shading over windows equal to 1.5' sunshade on east/south and west
Daylight harvesting lighting sensors
High-efficiency HVAC systems (including VRF system for each conditioned zone)
Passive ventilation strategies in certain areas (spaces not used as classrooms or offices)
Reduction in air infiltration between outside/inside or conditioned/unconditioned space

The results of these studies demonstrate an energy use intensity (EUI) of 23.6 kbtu/SF/year is achievable for these school buildings on the USVI.

A more detailed description of the assumptions and strategies from this modeling work is available in the appendix.

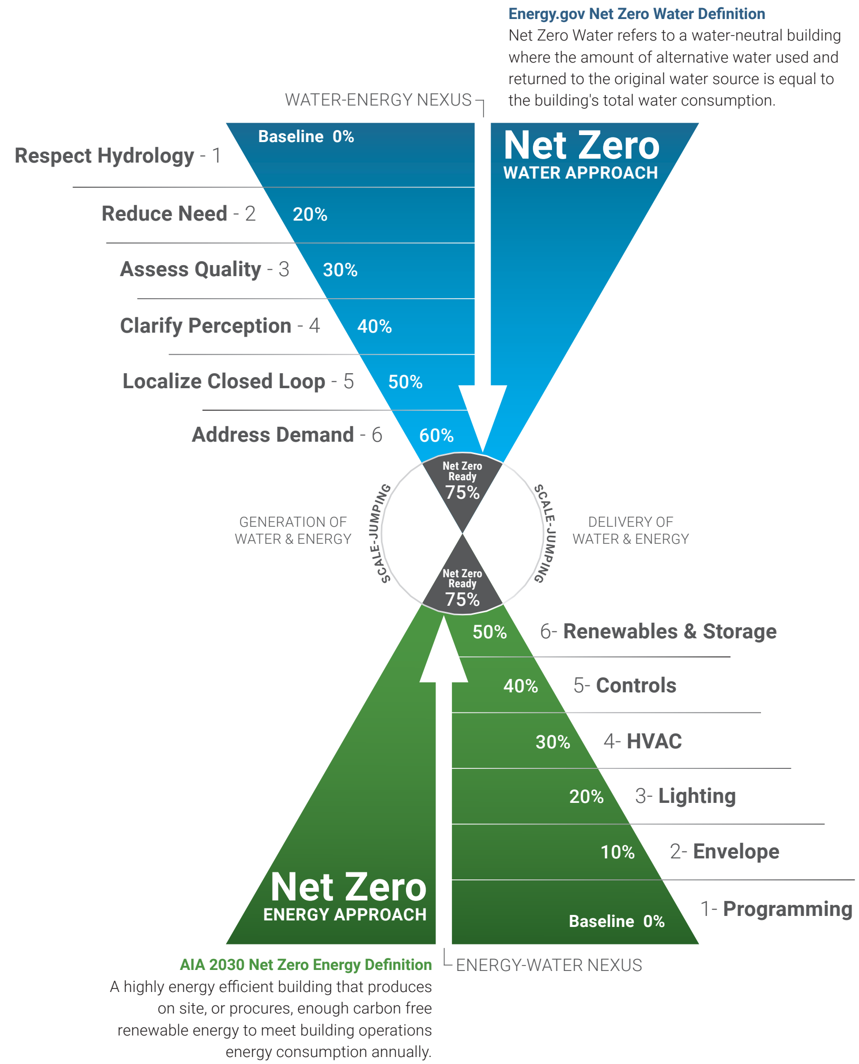
Resilient and Efficient Continued

Utilize LED light systems with simple controls – balance daylight & artificial light; switching and sensor to conserve energy and reduce heat gain. (Illumination Engineering Society: The Lighting Handbook, 10th Edition; RP-5-13 Recommended Practice for Daylighting Buildings; G-2-10 Guideline for the Application of General Illumination LED Technologies; LEED and WELL

Utilize vacancy sensors (widely) and occupancy sensors (occasionally, where necessary/appropriate) to reduce energy use and extend life of fixtures. Explore benefits and ROI of daylight harvesting.

Regarding exterior lighting design, lighting pollution and glare shall be minimized to the best extent possible. Guidelines set by the International Dark Sky Association shall be considered. Unless required otherwise by the building design. The minimum light levels recommended by the Illuminating Engineering Society shall be used. Wildlife impacts, such as turtle nesting or circadian disruption, shall be considered both from a light source and schedule standpoint. turtle nesting areas shall utilize turtle friendly amber sources, either as the main light source, or as a secondary light source scheduled to operate only during nesting periods.

Use Zero Mass Water Generation (or equivalent type of system) to produce potable water directly connected to drinking fountains inside the building. Utilize city water as back-up only.



Investigate if there is synergy between dehumidification & water production system.

Conserve potable water either generated on-site or from the city – only use for human consumption

Provide rainwater collection from roof into cisterns – reuse as grey water for toilet flushing or irrigation.

Use non-potable water for toilet flushing and irrigation (grey water systems) – see storm water management & rainwater capture above.

Wastewater – investigate suitability of city sewer vs septic system vs "living machine" (use of plants for filtration).

Waste – minimize landfill waste as much as possible

Minimize use of disposables in food service – use reusable dishes & utensils or compostables.

Invest in composting program for food scraps; dispense liquids (water; milk; juice, etc.) instead of disposable containers.

Establish recycle program – explore the options for recycling on the islands & determine the viability. Look to recycle paper, cardboard, plastics, glass & metal.

Improve access to technology to reduce the need for copying & printing when possible.

Ensure waste is stored appropriately (cool & sealed from pests) until it can be removed.

Establish best practices for food service.

reduce energy use, water use and waste production. Establish practices that make best use of resources and provide nutritious delicious food.

Understand local options for food production.

Evaluate necessary kitchen equipment based on healthy and nutritious plant-forward menu. Identify the number of full kitchens required in the district, as well as refrigerators and freezers on emergency power.

Identify the amount of cold and dry storage needed based on the menu. Discuss with VIDE the amount of storage required during events when the school facility becomes a shelter. Look for opportunities with space planning where the additional space needed during events can be used for other purposes during normal mode.

Sustainable foods VALUES card

Design Guidelines

Resilient and Efficient Continued

Additionally, the following design criteria have been requested by VIDE, WAPA or the Office of Energy:

Power:

WAPA's long term goal (5 to 7 years) is to have underground power service for all schools as the primary source for the entire campus

For redundancy and resiliency, WAPA recommends having generators and battery backups (or the ability to connect emergency generators to the school distribution system).

WAPA recommends having a resiliency plan that would support school power needs for 14-28 days after an event. To achieve this, the design strategies should target an Energy Use Intensity between 20-25 kBtu/sqft/yr and be Net-Zero Energy Ready, including the infrastructure for the addition of renewables such as a photo voltaic array on the building and/or site.

VIDE recommends planning to include administration offices and assembly spaces for backup power in addition to classrooms.

Regarding electrical systems, provide analysis of site electrical quality, including surges, dips, harmonics, short outages, etc. Where power quality issues exist, provide products or systems to help mitigate issues. These may include surge protective devices and/or sufficient battery storage capacity to ride through dips.

Regarding power distribution:

Design system to power loads from different sources (lighting, mechanical, plug loads) to allow for localized maintenance and separate metering.
Design system to meter loads (lighting, mechanical, plug loads) separately.

Provide power quality meter on main switchboard or panelboard.

Water:

WAPA may consider supplying underground potable water for all schools while trenching for power. On-site storage of rainwater is managed by VIDE.

VIDE currently tests for water quality for water from cisterns that are to be used for graywater needs and not for potable needs.
Waste Management provides sewer services.

Schools have a mixture of sewer and septic and so there is an opportunity to combine water reuse strategies to not only reduce water needs but also reduce demand for sewer systems.

Renewables:

Net metering for connected renewables is not allowed in the USVI. However, plans to provide Net Billing programs are under consideration.

Maintenance and operation of renewable energy systems installed in schools will be by WAPA as they are connected upstream of on-site electric meters.

Power Purchase Agreements (PPA) for funding and managing renewable energy systems are to be contracted with WAPA directly.

Rebates and Incentives:

The Energy Office can assist in accessing grants from Department of Interior, Department of Agriculture and other pertinent sources.

Operating Costs

The baseline cost at $0.23/kWh comes to about $5.5 million dollars annually and the Zero Net Energy (ZNE) ready cost will be about $3 million dollars annually for a total of 2 million SF. That is about $1.5/SF at USVI electric costs.

Joplin High School I Joplin, Missouri

Space Plan & Stuff

Establish "permeability index" – see discussion above regarding Services.

Protect spaces and goods & supplies during storms – protect openings & roofs; store bulk food & supplies and technology in spaces that can withstand storms & earthquakes; ensure storage is safe from pests/rodents

Locate systems within spaces so that they can be easily accessed & maintained.

For further information, reference case studies included in the advancement opportunities section specific to Charlotte Amalie High School recommendations for a replacement school.

Discovery PBL High School I Camas, Washington

Design Guidelines

Thermally, Visually and Acoustically Comfortable & Healthy

Teachers, students, and administrators engage better when in a space that is environmentally comfortable, that integrates daylight and appropriate artificial lighting solutions, exhibits appropriate acoustic performance, and minimizes the amount of disruptive outdoor and indoor noise affecting the classroom. Comfortable and healthy spaces reduce stress and promote better cognitive functions.

Skin and Space Plan

Design exterior to provide balanced natural light deep into learning spaces while avoiding heat gain and glare – utilize daylight and glare analysis to determine best use of windows; clerestories; light shelves and sunshades; better daylight improves test scores.

Provide appropriate ventilation for improved indoor air quality (EPA's Indoor Air Quality Tools for Schools REFERENCE GUIDE) – it improves cognitive function and reduces respiratory illness such as asthma, reduces potential for mold growth.

Maintain CO2 levels below typical standard recommendations in learning/working spaces – see Harvard's Chan School of Public Health CogFX Studies https://naturalleader.com/thecogfxstudy/study-1/view-the-reports/; calculate occupancy based on normal teaching/learning mode of school (not maximum occupancy) to size systems to meet CogFX recommendations, and utilize CO2 sensors for on demand ventilation response. Meet ASHRAE standards for calculated maximum occupancy ventilation requirements (in conditioned spaces) or current LEED for Schools credit for advanced ventilation. Provide on-demand ventilation systems that respond when spaces are in use that will improve air quality and reduce energy demand. MERV 13 filters recommended in ventilation systems to keep air clean.

Maintain ventilation and dehumidification to deter mold growth even during off-hours.

Minimize the number of small fully enclosed storage rooms – allow storage to ventilate to adjacent teaching spaces so that supplies are not affected by humid air. Provide ventilation/conditioned air to sensitive storage items such as instruments and food storage.

Provide air movement through large ceiling fans.

Provide appropriate acoustics – improves focus and learning; reduces stress.

Separate sensitive spaces acoustically (testing areas, office areas; IEP conf rooms); Provide STC 50 between all teaching spaces, STC 60 to Music/Dance/Fitness/Recording/ Mech, STC 45 to corridor/office/ conference room; Acoustical finishes NRC 0.70 equivalent to the entire floor area.

Provide acoustic mitigation strategies in learning spaces: minimize furniture noise and noise between groups of collaborating students; consider flexible/moveable solutions that can also define or divide space. Analyze and achieve appropriate reverberation times through design and materials in learning spaces (see ANSI s12.60 standard).

Ensure systems are quiet (achieve HVAC Background Sound of NC-30).

Provide vibration isolators for mechanical equipment that is on a roof or upper floor.

Design exterior envelope and systems to promote thermal comfort (see above on skin and systems); provide systems and controls in teaching spaces that allows for localized room adjustment as activities and equipment vary on a day-by-day basis.

Select materials to be durable, resistant to corrosion and resistant to mold growth; select healthy materials (low/ no VOC's; no flame retardants; avoid anti-microbials, heavy metals, PFAS, Bisphenols and Phthalates when possible); references: 6 classes of Chemicals (https://www.sixclasses.org/); Harvard's Sustainability Healthy Materials (https://green.harvard.edu/chemicals-concern).

Connect spaces and learning to nature via views from indoor learning/working spaces and outdoor learning/play spaces – supports cognitive development of adolescents; promotes calm & focus; reduces stress.

Include biophilic elements in interior spaces – 14 elements of Biophilic Design (https://www.terrapinbrightgreen.com/reports/14-patterns/)

Utilize patterns, colors, textures referencing nature in materials and art.

Utilize cultural elements and natural elements in the design language.

Reference Educational Facility Master Plan advancement opportunities section for exterior and interior diagrams of potential materials to be considered.

Left *Acoustic comfort VALUES card*

Design Guidelines

Easy to Maintain and Operate

Structure/Skin

Building exterior envelop (skin) that meets performance requirements to survive hurricanes/earthquakes/tsunamis with special attention to roof anchors & wall anchors; (FEMA 543 Design Guide for Flooding and High Winds).

To resist corrosion for sea air, provide stainless steel or copper sill pans, threshold pans, thru-wall flashing for rain screen construction or masonry cavity wall construction and valley roof flashing.

Stainless steel anchors/fasteners and hardware to resist corrosion (roof assemblies, wall assemblies, windows/doors, etc.).

Epoxy seal any exposed wood elements (wood rafters) to prevent deterioration.

To protect the waterproofing membrane, reduce heat island and to mitigate storm water provide green roofs at flat roofs whenever not being covered by photo voltaic panels. Provide access to roof area, regardless of type, for easy inspection and maintenance.

Flat roof structures to be concrete or composite deck with concrete.

Provide hurricane windows that meet Miami-Dade Counties Impact Testing requirements and that can resist hurricane wind loads. Windows should be anchored to the wall structure. Provide stainless steel hardware to resist corrosion.

Services/Space Plan

To save energy, minimize corrosion and mold and to ensure that systems are meeting owner's requirements and functioning according to design criteria, systems should be commissioned and re-commissioned based on GSA SFTool & LEED v4.1 for Schools BD+C & O+M recommendations.

Provide zoned control over the temperature, airflow, acoustics, and lighting to compensate for orientation and adjacencies.

Staff to be trained how to effectively operate and maintain systems.

Design spaces that are durable and easy to maintain – make valves, turn-offs, ballasts, fixtures, etc. clearly labeled and easily accessed without causing disruption to learning.

Right *Scappoose New Elementary School | Scappoose, Oregon*

Select materials for finishes and furniture that are healthy, create spaces for students to follow their passion – visual and performing arts, career and technical spaces; DIY Spaces (maker spaces) that are flexible and durable.

Hot dipped, aluminum, stainless or resin (plastic) frames to prevent corrosion.

Hard surface counters to avoid delamination in high humidity environments.

Marine grade fabrics and wood products.

Galvanized light gauge metal framing for non-structural walls that are designated as walls that can change in 5-10 years and for furring over CMU or concrete for electrical wiring.

Evaluate return on investment for using abuse resistant & mold resistant gypsum wall board, ceiling tiles, etc., especially in high traffic areas or modernization areas with air conditioning.

Provide insulation (such as Rockwool or equivalent) that repels water (hydrophobic), resists mold growth (inorganic), insulates and dries if it does get wet and is naturally fire-resistant.

Lighting fixtures outside of conditioned spaces shall also be constructed for the exterior environment. Fixture shall be constructed of marine grade materials (aluminum, stainless steel) or finished with a polyester powder coat finish that passes the following tests:

i. ASTM B117 Corrosion test
ii. ASTM D522 Cracking and loss of adhesion
iii. AAMA 2604 salt spray test.

See Whole Building Design Guide's Corrosion Prevention & Control (CPC) Source Overview (https://www.wbdg.org/ffc/dod/cpc-source/corrosion-prevention-control-source-overview#rcas), CPC Source - Best Practices Identified During The Facilities And Infrastructure Corrosion Evaluation Study (https://www.wbdg.org/ffc/dod/cpc-source/best-practices) & UFC 3-190-06 "Protective Coatings & Paints".

Regarding electrical systems, pathways above ground and outside of conditioned spaces shall withstand the humid and salty environment. Painting the conduit will not provide long term durability. Conduits such as aluminum rigid conduit (ARC), PVC coated conduit, or heavier galvanized rigid conduit (GRC) shall be considered to provide the electrical system with an appropriate life span. All of these consist of threaded terminations which will provide additional resiliency on rooftops, where compression and set screw fittings tend to pull apart.

Regarding lighting controls, simplicity of operation and maintenance shall be paramount in the lighting controls design.

Utilize current digital lighting control technology. Controls shall be networked to allow for programming maintenance to occur at a single point.

Locate control devices in easily accessible spaces such as above the ceiling over doorways, eliminating the need to move furniture.

Use out-of-the-box pre-commissioned systems where possible.

Switches shall be factory engraved or labeled with their functions, especially scene switches with multiple scene settings.

Design Guidelines

Healthy Learning Environments: A Focus on Health, Wellness and Nutrition

Services/Space Plan

Provide covered outdoor spaces for play, fitness and athletic activities at all schools. Provide sports fields and competitions gymnasiums for high schools.

Provide infrastructure to accommodate current & future technology.

Provide outdoor gardening opportunities where students learn to grow food; provide food labs where they can learn to cook and appreciate nutritious food.

Provide student services spaces such as counselors, social workers, school psychologists that are easily accessed by students – they should be adjacent to learning areas instead of within the depths of an administration office.

Provide spaces for teachers to relax and re-charge to reduce stress and improve performance, empathy & health.

Provide access to potable water through drinking fountains with integral bottle fillers.

Provide sinks in classrooms for hand-washing. Provide sinks ar nourishment stations within administration office suites and in teacher work and teacher lounge spaces for hand-washing. Distribute toilet rooms for both students & staff.

Kearney Early Education Center; Kearney, Missouri

Pathfinder Kindergarten Center | Everett, Washington

Stuff

Select furniture that is ergonomically designed and sized appropriately for both students and staff (ANSI/HFES 100 “Human Factors Engineering for Computer Workstation").

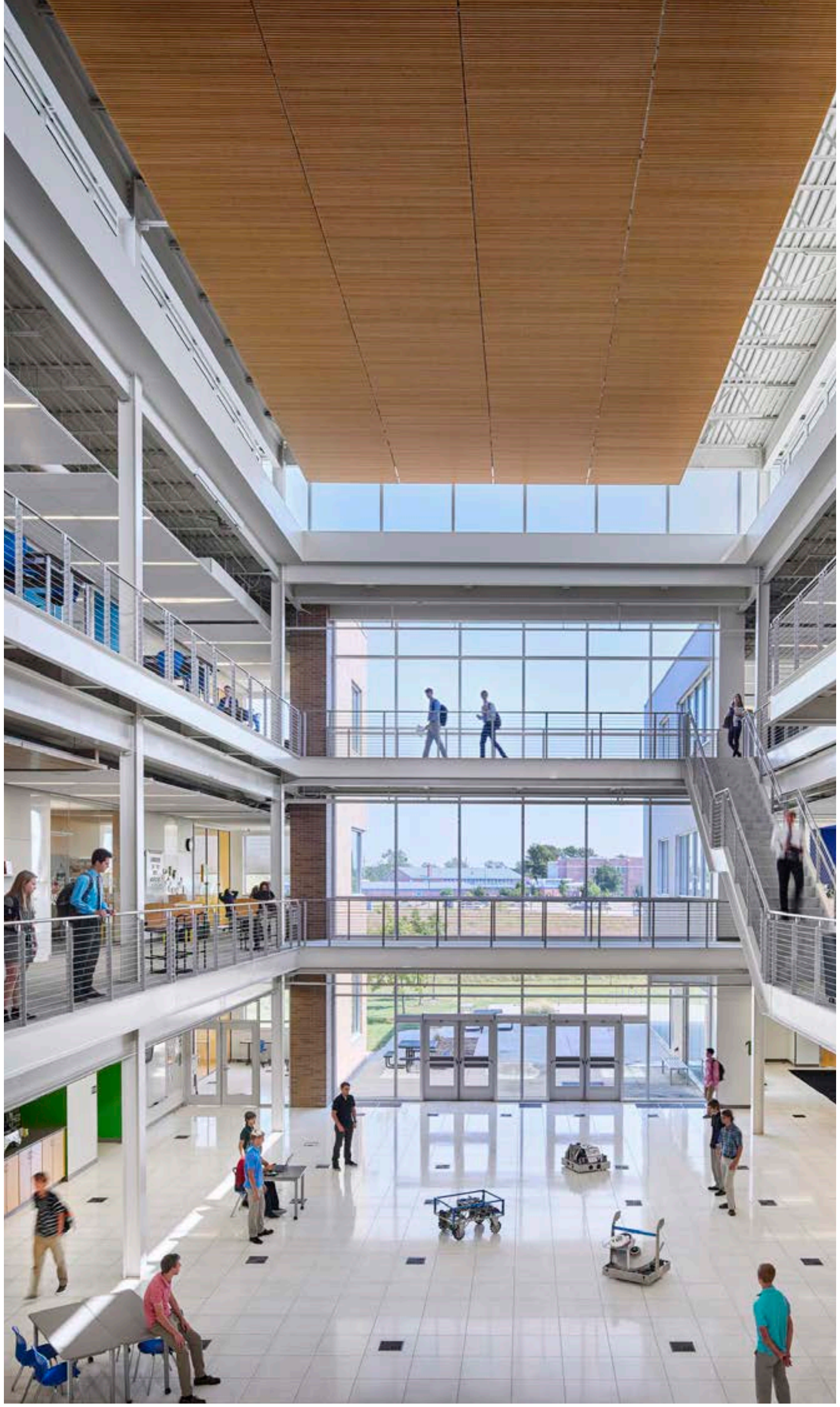
Allow for choice and movement;

Accommodate different learning styles & disabilities.

Adopt a health cleaning program utilizing green cleaning products (Collaborative for High Performance Schools standards).

Provide healthy materials that avoid the six classes of chemicals to the greatest extent possible, while also supplying materials that resist delamination and deterioration in a marine environment.

Reference Educational Facility Master Plan furniture specifications in the appendix for outdoor furniture considerations.



Right *Center for Advanced Professional Studies | Overland Park, Kansas*

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

FEMA

Section 1 Standards for Repair and Replacement: Indoor Environment

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Indoor Environment					
Thermal Comfort	Approved	American National Standards Institute	ANSI/ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy		Habitable spaces	
Lighting	Approved	Illumination Engineering Society	The Lighting Handbook, 10th Edition		Electric lighting	
	Approved		RP-5-13 Recommended Practice for Daylighting Buildings		Daylighting	
	Approved		RP-6-15 Sports and Recreational Lighting -		Athletics spaces	
	Approved		G-2-10 Guideline for the Application of General Illumination ("White") Light – Emitting Diode (LED) Technologies		Electric lighting	

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	**Conditions** (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Indoor Environment (continued)					
Hazardous Materials	Approved	Occupational Safety and Health Administration	OSHA's Construction Standards (OSHA 29 C.F.R. 1928.58)		Asbestos	Hazardous material in substrates and supporting elements for damaged components should be abated / replaced prior to installation of the new work.
	Approved		OSHA General Industry Standards (OSHA 29 C.F.R. 2910)		Asbestos	As above
	Approved	Environmental Protection Agency	EPA's Worker Protection Rule (EPA 40 C.F.R. 763)		Asbestos	As above
			EPA's NESHAPs (EPA 40 C.F.R. 61)		Asbestos	As above
			EPA's AHERA and ASHARA rules (EPA 40 C.F.R. 763)		Asbestos	As above
			EPA Lead Guidelines https://www.epa.gov/lead		Lead	As above
Noise and Acoustics	Approved	American National Standards Institute	ANSI/ASA S12.60 Part 1 American National Standard Acoustical Performance Criteria, Design Requirements, and Guidelines for Schools, Part 1: Permanent Schools, Acoustical Society of America		Habitable spaces	As above

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

Design Guidelines

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Indoor Environment (continued)					
Ergonomics	Approved (applicable to contents)	American National Standards Institute	ANSI/HFES 100 "Human Factors Engineering for Computer Workstations"		Habitable spaces	As above
Classroom environment	Approved	North Carolina Department of Public Instruction	Facilities Guidelines	See Appendix B in original submittal for further discussion of this standard.	Dimensional aspects of instructional environments	Classroom sizes, sizes of various spaces
	Approved	Whole Building Design Guide	Space requirements for facilities for children under seven (7) years of age		Space types, sizes and security features	As above
Science labs and classrooms						
Safety and security	Approved	Association for Learning Environments	Safe Schools, A Best Practices Guide https://www.a4le.org/pdf/knowledgecenter/SchoolSafetyGuide.pdf?hkey=8cc99e62-7d45-4db6-9cce-f6e1f5015a6f			As above
	Approved	American Institute of Architects CAE	The Design of Safe, Secure & Welcoming Learning Environments, http:/content.aia.org/sites/default/files/2019-08/CAE_Report_v6a_FINAL_print.pdf			As above

	Approved	American Institute of Architects CAE	Crime Prevention through Environmental Design: https://network.aia.org/viewdocument/using-crime-prevention-through-envi?CommunityKey=1b63a201-a510-41b7-b801-bca8083b5727&tab=librarydocuments			As above

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

Section Two Standards for Repair and Replacement: Building Structure

System/ Subsystem	**FEMA Determination**	**Source of Industry Standard**	**Industry Standard** (Specific Provision)	**Conditions** (under which industry standard shall be used)	**Application Practice**	**Additional Consequences / Broader Implications of Use of Industry Standard** (as applicable)
	Building Structure					
Structural Elements	Approved	Federal Emergency Management Agency	FEMA 424 Design Guide for School Safety Against Earthquakes, Floods, and High Winds	Existing facilities will be analyzed relative to code requirements as a matter of repair. These standards apply to mitigation of risk against future storm events.	Building structure	
			FEMA P-55 Coastal Construction Manual		Building structure	
			FEMA 453 Design Guidance for Shelters and Safe Rooms,	This will apply only to areas / facilities already constructed to function as shelters.	Building structure	
Masonry Bearing walls; shear walls	Approved	National Concrete Masonry Institute	NCMA Tek Notes		Masonry systems	Existing foundations must withstand the same loads as replaced, repaired, or reinforced bearing and/or shear walls. Foundations must be intact and not rotated. If piles exist, pile caps must be anchored to the piles. This may require Non Destructive Evaluation (NDE) to confirm if original documentation is not available.
Steel floor construction	Approved	American Institute of Steel Construction, Steel Deck Institute	AISC 360-05/10/16 Specification for Structural Steel Buildings, SDI 2017 Code of Standard Practice and the SDI Manual for Construction with Steel Deck		Steel with metal deck	
Steel Roof Construction	Approved	American Institute of Steel Construction, Steel Deck Institute; American Iron and Steel Institute	AISC 360-05/10/16 Specification for Structural Steel Buildings, SDI 2017 Code of Standard Practice and the SDI Manual for Construction with Steel Deck; AISI S240-15 North American Std. for Cold Formed Steel Framing 2015 Edition		Steel framing with light gage infill and/or metal deck	

Section Three Standards for Repair and Replacement: Building Shell

System/ Subsystem	**FEMA Determination**	**Source of Industry Standard**	**Industry Standard** (Specific Provision)	**Conditions** (under which industry standard shall be used)	**Application Practice**	**Additional Consequences / Broader Implications of Use of Industry Standard** (as applicable)
	Building Shell					
Exterior enclosure	Approved	Federal Emergency Management Agency	FEMA P-55 Coastal Construction Manual, Volume II, Chapter 11		Building Envelope	When evaluating existing assemblies, it is critical to assess the condition of supporting and surrounding structure.
Window systems	Approved	ASTM International	ASTM E2112 Standard Practice for Installation of Exterior Windows, Doors and Skylights –			Supporting wall assembly must have same lateral force resistance as replaced infill assembly
Door and entrance systems	Approved	Whole Building Design Guide	Doors Knowledge Area, https://www.wbdg.org/ffc/dod/cpc- source/doors-knowledge-area -			
	Approved	American National Standards Institute	ANSI/SDI-100		Hollow metal doors and frames	

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Building Shell (Continued)					
Door and entrance systems						
Roofing	Approved	National Roofing Contractors' Association	NRCA Roofing and Waterproofing Manual		Roof systems	When evaluating existing roof assemblies, it is critical to assess the condition of supporting structure.
	Approved	Federal Emergency Management Agency	FEMA 549, "Hurricane Katrina in the Gulf Coast: Mitigation Assessment Team Report, Building Performance Observations, Recommendations, and Technical Guidance", https://www.fema.gov/medialibrary/assets/documents/4069, July 2006		Facility repairs/ replacements	
			FEMA 543, "Risk Management Series – Design Guide for Improving Critical Facility Safety from Flooding and High Winds", https://www.fema.gov/media-library/assets/documents/8811, January		Facility repairs/ replacements	

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Building Shell (Continued)					
Sealants and weather barriers	Approved	ASTM International	ASTM C1472-16 Standard Guide for Calculating Movement and Other Effects When Establishing Sealant Joint Width		Elastomeric sealants	
			ASTM C1193 Standard Guide for Use of Joint Sealants		Elastomeric sealants	
			ASTM C920-18 Standard Specification for Elastomeric Joint Sealants		Elastomeric sealants	In existing facilities, destructive testing may be required to ensure continuity of air/moisture barrier and secondary sealant joints.
	Approved	Whole Building Design Guide	Air Barrier Systems in Buildings, http://www.wbdg.org/resources/ air- barrier-systems-buildings		Air barriers	

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

Section Four Standards for Repair and Replacement: Interior Construction

System/ Subsystem	**FEMA Determination**	**Source of Industry Standard**	**Industry Standard** (Specific Provision)	**Conditions** (under which industry standard shall be used)	**Application Practice**	**Additional Consequences / Broader Implications of Use of Industry Standard** (as applicable)
	Interior Construction					
Partitions		Gypsum Association				
	Approved		GA-600-2018 Fire Resistance and Sound Control Design Manual		Gypsum board assemblies	
Ceilings	Approved	ASTM International	ASTM E-580 Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions			
Woodwork and Casework	Approved	Architectural Woodwork Institute	Architectural Woodwork Standards		Casework and Wood Trim	

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Interior Construction (continued)					
Doors and glazing	Approved	American National Standards Institute	NFPA 80 Standard for Fire Doors and Other Opening Protectives		Fire rated doors and frames	
	Approved		ANSI/SDI-100		Hollow metal doors and frames	

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

Section Five Standards for Repair and Replacement: Plumbing

System/ Subsystem	FEMA Determination	Source of Industry Standard	Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
	Plumbing					

DLR Group

Section Six Standards for Repair and Replacement: HVAC

System/ Subsystem	**FEMA Determination**	**Source of Industry Standard**	**Industry Standard** (Specific Provision)	**Conditions** (under which industry standard shall be used)	**Application Practice**	**Additional Consequences / Broader Implications of Use of Industry Standard** (as applicable)
	HVAC					
HVAC Systems	Approved	American Society of Heating Refrigerating and Air- Conditioning Engineers	ASHRAE 2017 Fundamentals, Chapter 21		Ductwork sizing	
	Approved		ASHRAE 2017 Fundamentals, Chapter 22		Piping	
	Approved		ASHRAE 2017 Fundamentals, Chapter 20		Air diffusion	
	Approved		ASHRAE Standard 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings		Central plant sizing	
Adequate Ventilation and Filtration	Approved	American National Standards Institute	ANSI/ASHRAE Standard 62.1 Ventilation for Acceptable Indoor Air Quality		Minimum ventilation rates	

Industry standards for the U.S. Virgin Islands education sector.

Section Seven Standards for Repair and Replacement: Equipment and Furnishings

System/ Subsystem	Source of First Industry Standard	First Industry Standard (Specific Provision)	Source of Second Industry Standard	Second Industry Standard (Specific Provision)	Source of Third Industry Standard	Third Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
Equipment and Furnishings									
Display surfaces **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10415 Bulletin Boards, Display Boards, Display Cabinets and Cases http://www.nycsca.org/Design/Design-Standards#Specifications-86	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 05 00 Specialties Common Work Results, 10 11 00 Markerboard and Tackboard https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Visual Display Boards	
	Wake County Public School System	WCPSS Design Guidelines 11 52 13 Projection Screens https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	New York City School Construction Authority	NYCSCA Standard Specifications 11061 Platform Curtains, Auditorium Window Curtains, Projection Screen http://www.nycsca.org/Design/Design-Standards#Specifications-86	Houston Independent School District	Design Guidelines 10 01 00 Miscellaneous Specialties https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Projection Screens	
Signage **FEMA DETERMINATION** Approved (applicable to contents)	Wake County Public School System	WCPSS Design Guidelines 10 14 00 Identifying Devices https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 14 11 Interior Signage and Wayfinding https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Interior signage	
Athletic facilities equipment **FEMA DETERMINATION** Approved (applicable to contents)	Wake County Public School System	WCPSS Design Guidelines 11 66 00 Athletic Equipment https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Portland Public Schools	Division 11 "Equipment" https://drive.google.com/drive/u/0/folders/1G_rPLqI7rEvPJ5RMNNWKeJNlPnz9lRrl	Houston Independent School District	Design Guidelines 11 66 23 Gymnasium Equipment https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Gymnasium equipment	
Roller Window Shades **FEMA DETERMINATION** Approved (applicable to contents)	Wake County Public School System	WCPSS Design Guidelines 12 24 13 Roller Window Shades https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Portland Public Schools	Division 12 "Furnishings" https://drive.google.com/drive/u/0/folders/1UNrsqfLFMoU3OkqI2N2A3oYXbZ_b2j7S	Houston Independent School District	Design Guidelines 12 24 00 Window Shades https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf	Motorized would only be used where shades are not reachable.	Roller window shades	

System/ Subsystem	Source of First Industry Standard	First Industry Standard (Specific Provision)	Source of Second Industry Standard	Second Industry Standard (Specific Provision)	Source of Third Industry Standard	Third Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
Equipment and Furnishings (continued)									
Specialties / Toilet Compartments **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10185 Plastic Shower and Dressing Compartments http://www.nycsca.org/Design/Design-Standards#Specifications-86	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 21 13 Solid Polymer Toilet Partitions and Shower Compartments https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Toilet, shower, and dressing compartments.	
Specialties / Toilet Accessories **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10810 Toilet and Bath Accessories http://www.nycsca.org/Design/Design-Standards#Specifications-87	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 28 13 Toilet Room Accessories https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf	Owner usually provides any accessories that can be obtained from paper products supplier.	Toilet, shower, and dressing areas.	
Specialties / Lockers **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10505 Metal Lockers http://www.nycsca.org/Design/Design-Standards#Specifications-86	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 51 13 Metal Lockers https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Metal lockers	
Specialties / Storage Shelving **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10675 Metal Storage Shelving http://www.nycsca.org/Design/Design-Standards#Specifications-86	Houston Independent School District	Design Guidelines 10 56 13 Industrial Metal Shelving https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf	Atlanta Public Schools	Design Guidelines Division 10 Specialties - IX. Storage Shelving https://www.atlantapublicschools.us/cms/lib/GA01000924/Centricity/Domain/4657/2010%20Design%20Guidelines%2004%2020%2011.pdf		Storage shelving	
Safety Equipment **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 10522 Fire Extinguishers and Cabinets http://www.nycsca.org/Design/Design-Standards#Specifications-87	Portland Public Schools	Division 10 "Specialties" https://drive.google.com/drive/u/0/folders/1ruskz57dNjAPCjeLQB6xGmQTNCq6mgOu	Houston Independent School District	Design Guidelines 10 44 13 Fire Extinguishers and Cabinets https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf		Handheld fire extinguishers and cabinets	

Design Guidelines: Industry Standards

Industry standards for the U.S. Virgin Islands education sector.

System/ Subsystem	Source of First Industry Standard	First Industry Standard (Specific Provision)	Source of Second Industry Standard	Second Industry Standard (Specific Provision)	Source of Third Industry Standard	Third Industry Standard (Specific Provision)	Conditions (under which industry standard shall be used)	Application Practice	Additional Consequences / Broader Implications of Use of Industry Standard (as applicable)
Equipment and Furnishings (continued)									
Auditoriums **FEMA DETERMINATION** Approved (applicable to contents)	Wake County Public School System	WCPSS Design Guidelines 12 61 00 Fixed Auditorium Seating https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	New York City School Construction Authority	NYCSCA Standard Specifications 12710 Fixed Audience Seating http://www.nycsca.org/Design/Design-Standards#Specifications-86	Portland Public Schools	Division 12 "Furnishings" https://drive.google.com/drive/u/0/folders/1UNrsqfLFMoU3OkqI2N2A3oYXbZ_b2j7S		Fixed auditorium seating	
	Wake County Public School System	WCPSS Design Guidelines 26 50 00 Lighting https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Minneapolis Public Schools	MPS Master Specifications https://facilities.mpls.k12.mn.us/section_11_-_equipment.html	New York City School Construction Authority	NYCSCA Standard Specifications 16471 Auditorium and Television Studio Dimming System http://www.nycsca.org/Design/Design-Standards#Specifications-86		Theatrical lighting and dimmming systems	
	Wake County Public School System	WCPSS Design Guidelines 11 61 00 Stage Equipment https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Minneapolis Public Schools	MPS Master Specifications 11 61 33 Theatrical Rigging Systems and Controls https://facilities.mpls.k12.mn.us/section_11_-_equipment.html	New York City School Construction Authority	NYCSCA Standard Specifications 11061 Platform Curtains, Auditorium Window Curtains, Projection Screen http://www.nycsca.org/Design/Design-Standards#Specifications-86		Theatrical rigging systems	
	Wake County Public School System	WCPSS Design Guidelines 11 61 00 Stage Equipment https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Minneapolis Public Schools	MPS Master Specifications 11 61 43 Stage Curtains and Accessories https://facilities.mpls.k12.mn.us/section_11_-_equipment.html	New York City School Construction Authority	NYCSCA Standard Specifications 11061 Platform Curtains, Auditorium Window Curtains, Projection Screen http://www.nycsca.org/Design/Design-Standards#Specifications-86	For use in elementary, middle, and high schools.	Theatrical curtains	

System/ Subsystem	**Source of First Industry Standard**	**First Industry Standard** (Specific Provision)	**Source of Second Industry Standard**	**Second Industry Standard** (Specific Provision)	**Source of Third Industry Standard**	**Third Industry Standard** (Specific Provision)	**Conditions** (under which industry standard shall be used)	**Application Practice**	**Additional Consequences / Broader Implications of Use of Industry Standard** (as applicable)
	Equipment and Furnishings (continued)								
Telescoping Bleachers **FEMA DETERMINATION** Approved (applicable to contents)	Wake County Public School System	WCPSS Design Guidelines 12 66 00 Telecoping Stands https://www.wcpss.net/cms/lib/NC01911451/Centricity/Domain/91//Design%20Guidelines/2019%20Design%20Guidelines.pdf	Portland Public Schools	Division 12 "Furnishings" https://drive.google.com/drive/u/0/folders/1UNrsqfLFMoU3OkqI2N2A3oYXbZ_b2j7S	New York City School Construction Authority	NYCSCA Standard Specifications 12711 Telescoping Seating http://www.nycsca.org/Design/Design-Standards#Specifications-86		Telescoping seating	
Library Equipment **FEMA DETERMINATION** Approved (applicable to contents)	New York City School Construction Authority	NYCSCA Standard Specifications 11050 Library Equipment http://www.nycsca.org/Design/Design-Standards#Specifications-86	Houston Independent School District	Design Guidelines 12 56 51 Learning Commons Furniture - Wood https://www.houstonisd.org/cms/lib2/TX01001591/Centricity/Domain/7974/HISDDesignGuidelines.pdf	New York City School Construction Authority	NYCSCA Standard Specifications 11050 Library Equipment http://www.nycsca.org/Design/Design-Standards#Specifications-86			

Design Guidelines: Industry Standards

In addition to the industry standards submitted by the VIDE and approved by FEMA, the following documents were used to develop the advancement opportunities:

Austin (TX) Independent School District Educational Specifications for Modern Learning Environments

https://www.austinisd.org/construction-management/designinformation

Portland (OR) Public Schools Educational Specifications

https://www.pps.net/Page/2144

Massachusetts School Building Authority, Review and Recommendations of Best Practices For K–12 Stem Learning Spaces

https://www.massschoolbuildings.org/sites/default/files/edit-contentfiles/Building_With_Us/Ed_Facilities_Planning/FINAL%20STEM%20Spaces%20Report%20Foster%2012-2018.pdf

Americans with Disabilities Act (ADA) 2010 ADA Standards for Accessible Design

DoDEA Administrative Instruction 6055.01, DoDEA Safety Program, November 27, 2017. Section .11 on Ventilation

https://www.dodea.edu/Offices/PolicyAndLegislation/upload/AI-6055-01-DoDEA-Safety-Program-Signed-27-Nov-2017.pdf

Environmental Protection Agency, The Indoor Air Quality Tools for Schools Approach: Providing a Framework for Success

www.epa.gov/iaq-schools/framework-healthy-indoor-environments-schools; Page 3 recommendation on humidity levels to avoid mold growth.

FEMA 543 Design Guide for Flooding & High Winds

https://www.fema.gov/media-library-data/20130726-1557-20490-1542/fema543_complete.pdf

Guidelines on Assessment and Remediation of Fungi in Indoor Environments
New York City Department of Health and Mental Hygiene, November 2008, Moisture Control and Building Repair, pp 5-6.

Miami Dade County (FL) Testing Requirements for Exterior Fenestration (Wind-Borne Debris, Air & Water Tests), Especially for Windows & Doors

http://www.miamidade.gov/building/product-control.asp

Principles of Universal Design, United States Access Board

https://www.access-board.gov/guidelines-and-standards/communications-and-it/26-255-guidelines/825-principles-of-universal-design, December 7, 1995

U.S. Department of Energy, Energy Design Guidelines for High Performance Schools - Tropical Island Climates, https://www1.eere.energy.gov/buildings/publications/pdfs/energysmartschools/34274.pdf, November 1, 2004

Whole Building Design Guide:

Indoor Air Quality And Mold Prevention Of The Building Envelope
https://www.wbdg.org/resources/indoor-air-quality-and-mold-prevention-building-envelope, February 22, 2017

Enhance Indoor Environmental Quality
https://www.wbdg.org/design-objectives/sustainable/enhance-indoor-environmental-quality#rcas , March 18, 2018

Corrosion Prevention & Control (CPC) Design & Construction Issues
https://www.wbdg.org/ffc/dod/cpc-source/design-construction-issues, February 6, 2019

Waterfront And Coastal Structures Knowledge Area
https://www.wbdg.org/ffc/dod/cpc-source/waterfront-coastal-structures-knowledge-area, November 20, 2019.