SMART SCHOOLS CLEARINGHOUSE

Frugal Construction Standards

FINAL
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SMART Schools Clearinghouse
4050 Esplanade Way, Suite 235
Tallahassee, Florida 32399-0950

850-414-6796 (voice)
850-922-6149 (fax)
smartschools@mail.state.fl.us

http://smartschools.state.fl.us

Address all communications regarding these Frugal Construction Standards to the SMART Schools Clearinghouse at the address above.

William H. (Bill) Lindner, Chairman
SMART Schools Clearinghouse

The Florida Legislature, during its 1997 Special Session, established the SMART Schools Clearinghouse as the agency responsible for administering several programs designed to assist and encourage Florida's school districts to build S.M.A.R.T. schools. SMART schools were defined as schools which are Soundly Made, Accountable, Reasonable, and Thrifty.

As part of the SMART Schools initiative the Legislature directed the SMART Schools Clearinghouse to develop Frugal Construction Standards that ensure appropriate industry standards and optimal life cycles and that may include, but are not limited to, standards for optimal size of core facility space, design-build, performance contracting, energy efficiency, and life-cycle systems costing.

As the first step in meeting that obligation the SMART Schools Clearinghouse developed this booklet of "best practice" recommendations for building functional and frugal schools in Florida. The Clearinghouse recognizes that it would be difficult, and sometimes contradictory, to incorporate all of the standards described here and, therefore, these frugal construction standards are recommendations only.

The SMART Schools Clearinghouse encourages school districts to consider the recommendations described in this booklet and incorporate as many as practical and possible into their schools. By following a determined and straightforward approach to designing and building SMART schools Florida's school districts can make a significant impact on reducing the cost of building and maintaining schools while continuing to provide a high quality learning environment for our students.

The Clearinghouse gratefully acknowledges the participation and support of the SMART Schools Clearinghouse Workgroups and the time and effort devoted to making these Frugal Construction Standards meaningful. While we recognize that not everyone involved got everything they wanted, these standards represent a consensus of the broad spectrum of workgroup members and school district policy. The many hours workgroup members devoted to this project have been repaid with a document which has the potential to positively and significantly impact the way we design and build schools in Florida.

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DIVISION 1
GENERAL REQUIREMENTS

1.1 The school district should endorse and support a Partnering, or "Team Building" program and encourage all owner team members, design team members, and construction team members to actively participate and work toward maintaining a positive relationship throughout the project duration.

1.2 The design team should be encouraged to comply with the district's SMART school design philosophy and develop practical design solutions that are functional and cost effective.

1.3 When applicable, the design team, CM , and district facilities staff can help control construction costs by:

a. Being involved in development of the educational specifications and monitoring the cost implications of decisions made by the district's ed spec committee.
b. Studying the educational specifications and helping translate them into a precise program.
c. Being involved in site selection and helping determine the best utilization of potential school sites.
d. Questioning the Occupant Design Criteria Tables and looking for better and more efficient ways to allocate space within the school.
e. Seeking simple and straightforward architectural, civil, structural, mechanical, and electrical design solutions.
f. Monitoring the architectural, civil, structural, mechanical, and electrical planning and design solutions to control costs.
g. Producing complete, high quality construction documents.

1.4 The district should designate one person with the authority, and responsibility, to keep facilities construction projects within budget and on schedule.

1.5 The school district should develop a general project description that includes a brief statement as to why each facility is being built, where it will be located, the population of students it is intended to serve, its estimated cost, the method of financing, the estimated time schedule for planning and construction, and the estimated date of occupancy. Copies of the project descriptions should be made available to the public to help them better understand the needs of the district, and to help ensure that those persons responsible for delivering the project on time and on budget remain accountable.

1.6 Educational planners, instructional staff, and district facilities staff should cooperate to develop a complete set of educational specifications before the architect begins to design the facility. The educational specifications should include a description of activity areas that describe the type, number, size, function, special characteristics, and spatial relationships of instructional areas, administrative areas, and service areas in sufficient detail that the architect will be fully aware of what will occur in each of these areas.

1.7 The school should be designed to facilitate rapid and economical construction.
   a. The design should utilize standard sizes, types, shapes and readily available materials and trades to avoid waste and excessive labor costs.
   b. Architectural details should be simplified, durable, and contribute to rapid and economical construction and long-term low-cost maintenance and repair.

1.8 The facility should be designed with consideration given to long term ease of maintenance and repair. The facility's mechanical and electrical systems and building materials and systems should be determined, by value engineering or some other industry standard, capable of providing a minimum 20-year life-cycle.
   a. Exterior walls should be constructed with building materials that will provide long-term moisture and thermal resistance, low maintenance and ease of repair.
   b. Interior walls in corridors, cafeterias, and other high traffic unsupervised areas should be constructed with durable impact resistant materials.

1.9 New school plants should be planned to accommodate siting of future portables or expansion of permanent facilities when changes in demographics or rapid growth can be anticipated.

1.10 The facility should be adaptable to changes and innovations in education and flexible enough to accommodate a variety of program uses. Interior spaces should be simple with inherent versatility.

1.11 Interior walls and partitions within and/or separating instructional areas should be non-load bearing so the spaces can be reconfigured as instructional programs and needs change.

1.12 The school should be designed to be compatible with its surroundings but not be a trendy design that may be out of favor in a decade.

1.13 School districts should consider building one, or more regional multi-use sports/music/drama... complexs to be shared by several middle and high schools. Individual schools should have practice gyms, fields, and stages, when appropriate, but have their competitive games and performances at a regional complex. This would eliminate duplicating expensive facilities at each school and help reduce the construction costs of schools. A school district should also develop joint-use agreements and share the construction, operation, and maintenance costs of a multi-use complex with a local municipal or county government, further reducing the construction costs of its schools.

1.14 Consideration should be given to sharing parts or all of a facility, and its construction, operation and maintenance costs, with other governmental agencies. Also, consider developing policies that would allow leasing or renting parts of the facility after hours to other public or private entities.

1.15 Schools should be designed as compact, rather than campus, plans whenever possible to eliminate the additional costs associated with an extensive infrastructure, covered walks, and grounds maintenance. Designs should be developed to minimize gross floor area per student station while maintaining adequate floor area in instructional spaces.

1.16 The shape of buildings and rooms should be designed to help ensure the maximum and most efficient use of the space. Angled, circular, and other odd shaped rooms should be avoided except where a functional requirement.

1.17 All general purpose classrooms and instructional spaces should be a similar size and shape so that any curriculum can be taught in any one of them.

1.18 Ancillary and support spaces such as teacher planning, lounges, storage rooms, and conference rooms should be grouped, and centralized, where practicable, to help reduce the overall size of the school and its related infrastructure. Custodial closets, toilet rooms, and some other spaces may still have to be dispersed for practical reasons.

1.19 Consideration should be given to reducing the size of the library stacks area in the media center. Many books, reference, and resource materials are now readily available on electronic media eliminating some of the need for extensive shelving and casework to store books and resource materials.

1.20 Consideration should be given to maximizing passive design and "green architecture" concepts and techniques such as building orientation, shading walls and fenestration, using light colors on exterior walls and roofs, etc. to take advantage of, or minimize the negative impact of, the prevailing environmental influences.

1.21 The facility should be designed to allow after school hour activities to occur while keeping these activities segregated from the rest of the school for security, maintenance and operational needs.

1.22 Schools should only be designed and built with automatic fire sprinkler systems when required by code or when the total cost to build and maintain the school with fire sprinklers is determined to be less than the total cost to build and maintain the school with conventional Type IV construction and other requirements for schools without fire sprinklers. Vandalism to sprinkler heads and the consequences of inadvertent discharge should also be considered.

DIVISION 2 SITEWORK

2.1 Site development and landscaping should be designed to be functional, simplified, and easy to maintain and repair.

2.2 Parking and walks should be designed and constructed to efficiently move vehicular and pedestrian traffic and use as little area as practical.

2.3 School districts should consider the use of recycled asphalt for parking areas and drives whenever possible and practical.

2.4 PVC utilities (less irrigation lines) should have a tracer wire located directly above the line and terminated on a metal device accessible from the surface without excavation.

2.5 Storm water outfalls should have protection grates and horizontal energy dissipation pads.

2.6 Ground floor slabs should be designed to ensure that finished floor elevations are above adjacent finish site grades. Finish grades should be designed to shed surface water runoff away from the structures and buildings. Swales and runoff collection systems should be designed to ensure drainage away from all buildings. Renovation and remodeling projects should be designed to make modifications to the spaces and adjacent grades such that the above criteria is met.

2.7 The landscaping design and plant selection should include the use of plants native to Florida and other low maintenance materials. Xeriscape landscaping principals should be followed.

2.8 Landscape irrigation requirements should be kept to a minimum. Plant materials should be selected that will survive and flourish with comparatively little supplemental irrigation.

2.9 Site design and orientation should show awareness of the principles of “Crime Prevention Through Environmental Design” (CPTED) including natural access control, natural surveillance, and territorial reinforcement.

2.10 Preferably, downspouts should be connected to an underground drainage structure. However, as a minimum, splash blocks and drainage controls should be provided at

DIVISION 2
SITEWORK

the base of all downspouts to help reduce soil erosion and standing water around the buildings.

2.11 The civil engineer should be encouraged to design grades and earthworks such that the site is balanced as much as possible and import or excess fill is kept to a minimum.

2.12 The use of decorative brick, stone, and tile pavers should be avoided, when possible, at walking and driving surfaces.

2.13 Where possible, retention ponds should be shallow and dry to avoid the cost of fencing wet ponds.

DIVISION 3
CONCRETE

3.1 The school district should consider the use of other low cost and maintenance alternatives to reinforced masonry and concrete construction in school buildings.

3.2 The structural engineer should be encouraged to specify the minimum compressive strength concrete mix necessary to satisfy the design requirements of the specific component.

3.3 Stained or stamped concrete and decorative architectural precast components should be avoided.

DIVISION 4
MASONRY

4.1 Exposed concrete masonry units (CMU) and brick veneer mortar joints should be tooled concave or V-notch. Raked joints should be limited to interior use.

4.2 Brick, mortar, and CMU color and type should be selected from the suppliers and manufacturers standard utility types. Closure type brick, special fired colors, glazed block, architectural faced brick, and custom brick and CMU units should be avoided unless shown to be more economical for the given application.

4.3 Avoid using decorative glass block as exposed exterior wall surfaces.

4.4 Single wythe CMU exterior walls should only be considered if they can be designed and built to meet energy requirements, prevent leaks, and control the transmission of water vapor from the outside to the inside. Painted single wythe CMU is deemed to not meet this requirement. Such walls, if used, should extend below the finish floor slab elevation and not terminate on top of the finish floor slab. Cavity wall systems are preferred.

DIVISION 5
METALS

5.1 Exposed exterior structural steel and framing members should be kept to a minimum and not designed solely for aesthetic purposes.

5.2 The structural engineer should be encouraged to specify the minimum yield strength of structural and reinforcing steel necessary to satisfy the design requirements of the specific component and avoid exceeding the minimum required to meet code or design constraints.

5.3 Where possible, structural members should be readily available common sizes and shapes in lieu of special order or fabricated pieces.

DIVISION 6 WOOD AND PLASTICS

6.1 Fire retardant treated wood treated with salt solutions should be avoided. FRTW should not be used except where specifically required by code or design constraints.

6.2 Toe boards of base cabinets, in contact with floors which are often mopped or shampooed, should be constructed of pressure treated lumber and finished with plastic laminate or vinyl base material.

6.3 Plastic laminate colors and patterns should be from the manufacturers readily available standard product lines.

6.4 Plastic laminate counter tops and back splashes within 4-feet of either side of a sink should be built of 3/4-inch exterior grade plywood with plastic laminate finish. Seams in plastic laminate should not be within 18-inches of a sink opening.

6.5 Built-in casework should be kept to a minimum in classrooms to help reduce initial building costs and ensure that the spaces remain flexible and responsive to future changes in program.

6.6 Science and chemistry lab casework counter tops should be acid resistant pressure laminated plastic in lieu of "chem-resin" composite materials unless the district requires the use of concentrated acids in the curriculum.

DIVISION 7 THERMAL AND MOISTURE PROTECTION

7.1 Roofs should be designed and constructed with durable building materials which provide rapid and economical construction and long-term low-cost maintenance and repair.

7.2 School districts using built-up roofs should consider specifying coal tar saturated felts and coal tar pitch. Asphalt saturated felts and asphalt pitch should be avoided. If there is concern about the toxic fumes produced by coal tar pitch and its derivatives, alternative roofing systems should be considered.

7.3 Parapets should be minimized, or avoided, where possible; however, recognize that parapets may help minimize wind damage on low slope (flat) roofs. Coping should be mechanically fastened to the structure and no adhesive type coping should be used.

7.4 New roofs should have positive drainage with all runoff collected into gutters and downspouts. Avoid interior roof drains when possible.

7.5 Roof gutters and downspouts should be provided as required to direct waterflow away from exterior walls and sidewalks.

7.6 Avoid installing mechanical and other equipment on roofs. However, if it is necessary to have rooftop mounted equipment it should be provided with maintenance and walkway pads.

7.7 Districts using asphalt shingles should specify that they be nailed with hot-dipped galvanized (not electro galvanized) nails. Staples of any type should not be used.

7.8 Roof penetrations should be kept to a minimum. Roofs and roof systems should be designed to minimize the need for flashing and complicated flashing details should be avoided.

7.9 School districts using metal roofs should specify that the materials and installation will be warranted watertight for hurricane force winds. Metal roofs should be specified with concealed fasteners.

**DIVISION 7
THERMAL AND
MOISTURE
PROTECTION**

7.10 If used, Exterior Insulation and Finish Systems (EIFS) should be durable, long lasting and easily maintained and repaired. Specify EIFS systems with internal drains, weeps, or other mechanism which will ensure that water entering the system will drain back out. EFIS wall systems should be avoided in areas that may be subject to damage or vandalism.

DIVISION 8
DOORS AND WINDOWS

8.1 Exterior doors should be designed to ensure that wind driven rain and water from roofs does not enter the building through exterior door heads, jambs or sills.

8.2 All exterior doors and frames should be protected from the weather, i.e., by roof overhangs, eyebrows or recesses.

8.3 The finish on steel and aluminum door and window frames should be selected from the manufacturers' readily available standard colors and finishes. Avoid special order colors and finishes.

8.4 To the greatest extent possible, standardize finish door hardware and window hardware and specify that it all be from the same manufacturer.

8.5 Window areas should be kept small enough to allow a high degree of efficiency in heating and cooling while maintaining compliance with SREF and other building codes. Window areas should not be oversized unless required by an overriding design constraint.

8.6 The district should consider using interior doors with a streatched head door frame, which aligns with CMU and brick coursing, to eliminate the need for installing custom headers.

8.7 Soft coating, low 'e' type glazing should be avoided unless tradeoffs can be made in first costs to justify installing and maintaining this type of glass in schools.

8.8 School districts should consider using impact resistant shutters in lieu of impact resistant glazing when the cost of installing and maintaining the shutters is less, or when an exposed laminate layer of the glazing is susceptible to scratching.

8.9 Districts should consider using hollow metal doors with an STC rating of 38, in lieu of the standard STC 42, when the increased sound transmission can be tolerated.

DIVISION 9
FINISHES

9.1 Finishes should be of durable materials which contribute to the facility's rapid and economical construction and long-term low-cost maintenance and repair.

9.2 Where ceramic, glazed and quarry floor tile is used, it should be non-slip and finished with an appropriate sealer. Consider limiting ceramic tile in restrooms to only fixture walls and floors. Decorative ceramic tile should be avoided.

9.3 Vinyl wall coverings, and other impermeable interior finishes should be avoided.

9.4 Fire rated ceiling tile should be used only where required by code or application.

9.5 Consider using carpet as a floor covering only in administration offices, media centers, band and chorus rooms, or where the curriculum and program require carpeted floors.

9.6 When used, acoustical tile ceiling systems should be standard 2x4 or 2x2 configurations. 2x2 systems are preferred. Avoid the use of curved or architectural type ceiling systems and components. Consider using acoustic rated tile ceiling systems in lieu of sound insulated walls above the ceiling where sound transmission is a concern.

DIVISION 10
SPECIALTIES

10.1 Aluminum walkway canopies and covers should be selected from the manufacturers' readily available standard colors, shapes, and sizes. Avoid using custom colors or extrusions unless shown to be economically feasible.

10.2 The district should consider using stainless steel mirrors, in lieu of glass, in all student toilets.

10.3 Avoid locating fire extinguisher cabinets on the exterior of any building.

10.4 Toilet partitions should be constructed of seamless, solid material with homogenous composition and color throughout. Toilet partitions should be floor mounted and overhead braced, with tamper resistant, rust proof fasteners, brackets, latches, and hinges. Urinal partitions should be avoided where possible; however, when provided they should be solidly anchored and braced.

10.5 If student toilets are equipped with wall hung lavatories, the lavatories should be mounted with a modified wall bracket suitable for use in the school environment. If counters are used for installation of lavatories in student toilets, the counter should be constructed of seamless, solid material with homogenous composition and color throughout.

10.6 Flagpole heights should be limited to no higher than thirty feet (30') above finished grade.

10.7 Site signage should be economical in design and compatible with the surrounding neighborhood. Decorative architectural details and enhancements should be avoided.

10.8 Specialties and accessories should be standardized throughout the school district.

DIVISION 11 EQUIPMENT

11.1 Equipment should be durable and easy to maintain and repair.

11.2 Select equipment from well known “brand name” manufacturers with a reputation for good customer service and the resources to promptly respond to warranty and repair claims.

DIVISION 12
FURNISHINGS

12.1 Telescoping bleachers should be specified and installed using the manufacturers' standard modular system dimensions in lieu of a custom manufactured type and size.

12.2 Methods for walking off dirt and sand should be provided at all entrances to buildings. These areas should be designed for ease of maintenance and, if grates, grids or mats are used they should be in sections light enough for one person to remove and replace.

DIVISION 13 SPECIAL CONSTRUCTION

13.1 Special constructed facilities such as air supported structures, clean rooms, and sound conditioned rooms should be avoided unless required to support a specialized curriculum or need.

13.2 Pre-engineered structures should be considered as an alternative to “traditional” reinforced concrete and CMU structures for school facilities. If pre-engineered structures are specified, exposed fasteners on roof surfaces, except those required for maintenance, should be avoided.

DIVISION 14 CONVEYING SYSTEMS

14.1 Schools should be designed to minimize the need for duplicate elevators and lifts to accommodate the physically disabled and repair and maintenance operations.

14.2 Moving stairs, walks, and other costly, high maintenance conveying systems should be avoided.

DIVISION 15 MECHANICAL

15.1 HVAC and plumbing systems should be designed to ensure rapid and economical construction and contribute to the facility's long-term low-cost maintenance and repair.

a. Mechanical systems should utilize standard sizes, types, and readily available materials and components.

b. Materials and components should be traditional and durable.

15.2 The school district should consider a decentralized HVAC system when it would be more cost effective and provide greater operational flexibility than a large centralized chiller. Consideration should also be given to including alternatives such as geothermal, ice storage, and solar components in the HVAC system.

15.3 All buildings should be designed to operate in a positive pressure state, using adequately conditioned outside air to achieve pressurization. Ideally, buildings should be pressurized at all times to avoid infiltration of moisture and contaminants. Consideration should also be given to separating the ventilation/pressurization system from the temperature/humidity system.

15.4 If used, an energy management system should be designed and installed which is appropriate for the level of training and expertise of personnel available to operate and maintain it.

15.5 When possible, HVAC systems, controls and components should be standardized throughout the district.

15.6 HVAC equipment, conduits and piping should not be installed on roofs except where vandalism, safety, or other economic and operational factors are a concern.

15.7 Mechanical rooms should be of sufficient size to allow recommended service and maintenance clearances for all mechanical equipment. Air handling units serving classrooms should be accessible from outside of the classroom unless design and operational constraints dictate otherwise.

15.8 Air handling units, VAV boxes, fan coil units, and other equipment which generate condensate, handle fluids, or require frequent servicing or filter changes should be located to minimize damage from leaks and to allow easy access for maintenance and repair.

15.9 Operation and maintenance manuals should include, as a separate item, preventive maintenance requirements along with time schedules for each item.

15.10 Complete sequence of operations manuals and equipment control training should be provided to the maintenance personnel at the completion of the project. Ideally, training should be video taped and filed for future reference.

15.11 Whenever possible, intakes and exhausts should be installed in soffits, overhangs or gable ends of buildings in lieu of on the roof. Exhaust fans should be provided with back draft dampers.

15.12 Fresh air intakes should be located away from loading docks, exhaust fans, dumpsters, cooling towers, boiler exhaust, and sanitary vents to help ensure that obnoxious odors, fumes, and gases are not drawn into the air supply.

15.13 Glass and plastic acid waste pipe should not installed in schools unless required by code or needed for a specific curriculum application.

15.14 All copper water lines through masonry and concrete walls and floor slabs should be sleeved. Consideration should be given to using schedule 80 PVC for domestic water lines in lieu of copper.

15.15 Wall mounted water closets should be installed using a modified wall bracket designed to withstand the rigors of a school environment. Ideally, water closets should be floor mount type fixtures.

15.16 Stop valves should be installed on all fixtures and isolation valves located to allow shut off of individual groups of plumbing fixtures. Hose bibbs should be operated by a removable key only.

15.17 Lavatories should be equipped with metered water faucets or sensor controls.

DIVISION 15 MECHANICAL

15.18 Mechanical rooms, as well as toilet rooms, should have floor drains with trap primers, hose bibbs, and adequate lighting.

15.19 Potable, chilled, and hot water piping systems should be designed with accessible isolation valves entering each building.

15.20 Where applicable, the entire potable hot and cold water system should be installed within the thermal envelope of the building to minimize damage to the system during freezing. All water piping above grade and outside the thermal envelope should be protected from freezing by providing heat tracing and insulation.

15.21 PVC should be used for condensate lines, in lieu of copper or other more costly materials, when conditions permit and algae growth can be controlled.

15.22 PVC should be considered for waste lines and risers, except in air plenums, in lieu of cast or ductile iron, when conditions permit.

DIVISION 16 ELECTRICAL

16.1 All empty raceways should be equipped with continuous pull strings and marking tags, showing opposite destination building and closet number, at each end.

16.2 Gas line shutoff valves activated by the fire alarm system should have reset switches accessible from a convenient location.

16.3 Fluorescent lighting, if used, should be T-8 lamps with electronic ballasts. When practicable, use the same type and size of lamp throughout the facility.

16.4 Consider using motion or heat sensing light switches only in offices or other spaces with infrequent or sporadic lighting needs. Classrooms and other instructional spaces should be equipped with manual lighting controls such as shades, blinds, and/or multiple light switches.

16.5 Surge protection should be provided for all wiring entering and leaving buildings.

16.6 The school's artificial lighting system should be designed to take full advantage of available natural lighting to help reduce operation and maintenance costs. Window areas should be designed to allow a high degree of efficiency in heating and cooling and to aid in lighting interior spaces and during power or equipment failures.

16.7 Exit lights should be the LED type, when conditions permit.

16.8 Districts should consider using plain aluminum, fiberglass, or precast concrete parking lot light poles with economical, energy efficient fixtures in lieu of decorative aluminum or architectural type poles and fixtures.

16.9 Interior light fixtures, and their placement should be designed to minimize the amount of glare on chalk boards, marker boards, computer screens, and other teaching aides.

16.10 The electrical distribution system should be sized with spare ampacity and spares/spaces for future breakers.

16.11 Lightning protection should be considered when the location of the school indicates a need and warrants the additional cost of providing the protection.

DIVISION 17 TECHNOLOGY SYSTEMS

17.1 The facility should be designed and constructed for technology connectivity.

a. Voice, video, and data connections should be installed in every classroom and every other occupied space should be equipped with an appropriate number of voice, video, and data transmission connections.

b. Internet access should be provided in all instructional areas and other appropriate locations throughout the school.

17.2 All underground and riser raceway communications cable systems, and electrical systems cabling should be installed continuous (with no splices) between buildings and floors, when possible. If distance makes this impossible, above ground enclosures should be provided.

17.3 All voice, video, and data transmission raceways, wall and floor boxes should have individual, direct pathways ("homeruns") to the appropriate communications closet or communications equipment room, as applicable.

17.4 Surge protection should be provided for all wiring entering and leaving buildings.

17.5 To permit the data distribution system to be replaced with new future technology (i.e., wireless), the data distribution system should not be integrated with other more stable types of systems.

17.6 Voltage drops and spikes can cause damage to files and computer components. It is recommended that computer power be separated from the HVAC power supply, other circuits with motors, and other devices which may cause voltage drops and spikes or, install constant voltage transformers and MOV surge protectors, whichever is more cost effective.

17.7 The Institute of Electrical and Electronics Engineers (IEEE) does not recommended isolated ground systems for computers. Therefore, the district should consider not installing isolated ground outlets (special outlets) or isolated ground circuits and transformers, if appropriate considering local conditions and circumstances.

**DIVISION 17
TECHNOLOGY
SYSTEMS**

17.8 Digital switching power supplies are immune to electrical noise. Therefore, technology power and convenience power (general use power) may not need to be separated in the classroom.

17.9 Classroom lighting should be separated into at least two zones, with separate switches, that allow the front of the room, where a projection screen would be located, to be darkened.

17.10 When designing HVAC for technology, consider that five computers can raise cooling needs by twenty-five percent and twenty computers can double the cooling needs of a room.

17.11 Video displays should be installed on walls adjacent to ambient or direct light sources.

17.12 A standard acrylic lense on a light fixture may scatter the light and cause glare on video displays. Consider using a "Paracube" lens on standard fixtures or deep cell parabolic fixtures in rooms with computers.

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