Specialties

Examples – Specialties

- Visual display boards
- Fire Extinguishers
- Wire mesh security partitions
- Standard lockers
- Athletic lockers
- Metal toilet compartments
- Plastic toilet compartments

Performance Guidelines – Specialties

- Sturdy, well-constructed
- Maintenance-free
- Ability to easily replace damaged components
- Choose quality manufacturers
- Wide range of color selections
- Durable, easy-to-clean finishes
- Use recycled/recyclable material if available
- Consider use of materials and products local within 500 miles of project

Visual Display Boards, Fire Extinguishers, Wire Mesh Security Partitions

Examples

- Marker boards
- Tack boards
- Fire extinguishers
- Wire mesh security partitions

Construction Standards – Boards, Extinguishers, Wire Mesh Partitions

1. Marker boards: Porcelain enamel face sheet with high gloss finish; 3/8 inch particleboard core; .005 inch aluminum foil backing; anodized extruded aluminum trim
2. Tack boards: factory built, vinyl covered, 3/8 inch industrial grade fiberboard core material; or, vinyl impregnated cork (natural or colors); with anodized extruded aluminum trim
3. Fire extinguishers: comply with NFPA, the Arkansas Fire Prevention Code and accessibility guidelines (ADA) with the type and size selected for use in specific areas
4. Wire mesh security partitions: cold-rolled steel C-section channels for vertical members and steel channels for horizontal frame; 10 gauge steel wire woven into 1-½ inch diamond mesh

Lockers & Toilet Compartments

Examples

- Standard lockers
- Athletic lockers
- Metal toilet compartments
- Plastic toilet compartments

Construction Standards – Lockers and Toilet Compartments

1. Standard lockers: comply with accessibility guidelines (ADA); form body from steel sheet; assemble locker units by bolting together; steel frames and doors; recessed handle and latch; baked enamel finish
2. Provide ADA lockers for the physically challenged in physical education area
3. Athletic lockers: (punched type) 20 gauge sheet steel with diamond shaped perforations for sides; 20 gauge perforated steel doors; and baked enamel finish
4. Athletic lockers: (expanded metal type) 0.0897 inch expanded metal backs, sides, and doors; baked enamel finish
5. Metal toilet compartments and urinal screens: zinc-coated steel sheet ASTM A 591, Class C consisting of 18 gauge overhead braced pilasters; 20 gauge partition panels with a sound deadening core; 22 gauge doors with stainless steel door hardware; electrostatic and baked enamel paint finish; and polished anodized aluminum rails and mounting brackets. Consider stainless steel finish only in high humidity areas where a corrosive environment exists.
6. Solid plastic toilet compartments: Solid high-density polyethylene (HDPE), polypropylene (PP) or solid phenolic core construction not less than 1 inch thick. Recycled content of HDPE to be within range of 20-35%.
7. Toilet compartments shall be floor mounted, overhead braced, or ceiling mounted

Equipment and Furnishings

Examples – Equipment and Furnishings

- Theater and stage equipment
- Projection screens
- Athletic Equipment
- Educational casework
- Science casework
- Telescoping bleachers

Performance Guidelines – Equipment and Furnishings

- The K-12 school environment requires special needs for equipment and furnishings
- These items must be strong and sturdy to last many decades
- Manufacturers must specialize in these areas to meet the broad age range of students
- Safety of their products is essential and they must meet standards, codes, and accessibility guidelines
- With casework, environmentally preferable product alternates should be utilized, such as oriented strand board (OSB) and recycled plastic
- Equipment and furnishings must be as maintenance-free as possible and easily cleaned

Theater, Stage, Projection Screens, and Athletic Equipment

Examples

- Theater and stage equipment
- Projection screens
- Athletic equipment

Construction Standards – Theater, Stage, and Athletic Equipment and Projection Screens

1. Material: woven velour fabric.
2. Fabrics shall be flame resistant.
3. Curtain tracks as recommended by manufacturer
4. Stage rigging and fire curtain systems shall meet all fire and life-safety codes and OSHA safety requirements

Performance Guidelines – Theater, Stage, and Athletic Equipment and Projection Screens

- Theater-electrically operated projection screen: 3 position control switch with metal device box for flush wall mounting and for connection to 120v, AC power supply; screen same as manual screen
- Manual, front projection screen: matte white, vinyl coated glass fiber fabric complying with FSGG-5-00172D for Type A screen surface; 80 inches by 60 inches in classrooms
- Athletic equipment to comply with National Federation of State High School Associations
- Basketball backboards: 72 inch by 42 inch, ½ inch thick transparent, tempered glass
- Wall-mounted safety pads: 14 ounce PVC coated polyester or nylon reinforced PVC fabric; pad cover over 2 inches, 6 lb. density polyurethane over composite panel

Educational Casework and Bleachers

Examples

- Educational casework
- Science casework
- Telescoping bleachers

Construction Standards – Educational Casework and Bleachers

1. Formaldehyde free and low VOC
2. Casework shall conform to ADA guidelines and state and local regulations
3. Countertops shall not deflect more than ¼ inch when a 100 lb. /ft. load is applied
4. Shelving shall be capable of supporting 25 lbs./sq.ft.
5. Countertops shall be .048 inch thick plastic laminate conforming to NEAM HG5
6. Exposed surfaces shall be .028 inches thick plastic laminate conforming to NEMA NG5
7. Hardware: conform to ADA; standard finish, commercial quality, heavy duty
8. Provide (1) year warranty on casework
9. Lab casework: solid wood and plain sliced veneer plywood, or high pressure plastic laminate NEMA LD3
10. Countertops: 1 inch thick, epoxy resin and cast epoxy resin sinks
11. Locks: cylinder type, 5 disk tumbler mechanism
12. Hinges: 5 knuckle with hospital tips, .090 inch steel, 270 degree swing complying with BHMA 156.9, Grade 1
13. Telescoping bleachers shall comply with NFPA 102, Chapter 5, “Folding and Telescopic Seating”
14. Provide five (5) year warranty for bleachers

Performance Guidelines - Educational Casework and Bleachers

- Maximize use of recycled/recyclable materials
- Consider local materials (within 500 miles)
- Consider molded polyethylene plastic seats

Plumbing

Components – Plumbing

- Site Utilities
- Valving
- Hangers
- Identification
- Testing
- Potable Water Systems
- Domestic Water Heater Systems
- Water Conditioning and Softening Systems
- Sanitary Piping Systems
- Gas Piping System
- Roof Drain and Storm Sewer System
- Food Service Area Systems
- Building Fire Protection Systems
- Plumbing Fixtures and Specialties

Standards – Plumbing

1. This section establishes the minimum design requirements that must be incorporated into the project by the Plumbing Design Professional. Minimum code requirements are the current editions of the Arkansas State plumbing and gas codes. Local codes and standards shall take precedence over these requirements, provided said codes and standards are more stringent.
2. All systems shall be designed in compliance with the current Arkansas Energy Code.

Standards – Plumbing Site Utilities

1. Determination of the available site services with regard to gas service, sanitary systems, storm water systems, domestic water systems, and fire service systems is necessary as a part of the site selection process.
2. The building plumbing system is to be complete to 5 feet outside the perimeter of the building foundation and shall include all piping, fixtures, appurtenances, and appliances in connection with a supply of potable water (except for fire sprinkler systems), sanitary drainage or storm drainage systems within or adjacent to any building, structure, or conveyance on the premises. The connection to a utility water meter or other public water or sewer utility system or other source of potable water or sewage disposal and storm water structures shall be designed by the Site Utility Design Professional from 5 feet outside the perimeter of the building foundation system. Food service grease interceptors, science room acid neutralizing sumps, and gas piping and regulators shall be designed by the Plumbing Design Professional.
3. The Plumbing Design Professional is required to evaluate the anticipated demand and method of supplying gas service to the building. All natural gas piping systems

Design Guidelines – Plumbing Site Utilities

1. Consideration should be given to providing a metering device to measure all water usage for new buildings over 20,000 SF
2. Consideration should be given to providing a metering device to measure all gas usage for new buildings over 20,000 SF

shall be installed in accordance with the Arkansas gas code. The estimated gas loads for operation of the water heating boilers, domestic water heaters, food service equipment, science program usage, and miscellaneous items shall be obtained from the appropriate disciplines by the Plumbing Design Professional and totaled with the inclusion of a growth or safety factor. Discussion with the local gas company is necessary, both to determine potential service costs and to determine the responsibilities of the building owner and the gas company regarding installation. Determine the gas pressure requirements for the equipment in the building and communicate this need to the gas company. The Plumbing Design Professional or Site Utility Design Professional shall design the gas service.

Liquid Propane

- If natural gas service is not available, the installation of liquid propone gas should be investigated.

Standards – Plumbing Valving

1. Valves will be installed to isolate individual plumbing fixtures and groups of plumbing fixtures to permit shut down of the fixture or equipment without affecting the remainder of the building.
2. The domestic water system valves shall be bronze construction gate valves or valves with a ball-type conventional port.
3. The gas supply to science rooms and art rooms shall have an emergency solenoid-type, automatic shutoff valve with a manual reset. The purpose of the valve is for shut down of the gas in case of an emergency or when the fire alarm system is activated. A solenoid-type, automatic shutoff valve with a manual reset shall be installed to shut the gas off to the appliances under the kitchen hood in the event there is a fire under the hood. The valves are designed normally closed and are held open by an electric solenoid valve. A mushroom-type wall switch shall be located in the room for solenoid activation.

Condensate Discharge

- The plumbing design professional should coordinate with the HVAC design professional and local utility to determine best practice for cooling system(s) condensate discharge.

Standards – Plumbing Hangers

1. Provide hangers for all horizontal, suspended, domestic, water, gas, sanitary, and storm piping with distances as noted in the state and local codes.

Standards – Plumbing Identification

1. Piping shall be identified in mechanical rooms, unfinished spaces without ceilings, above suspended lay-in acoustical ceilings, and crawl spaces for the type of service and direction of flow. Equipment shall be identified with nameplates.

Standards – Testing

1. Domestic water, storm and sanitary sewers, and gas piping shall be tested per state and local codes.

Standards – Potable Water Systems

1. All buildings shall include a potable domestic water system serving all sinks, toilets, showers, food service, custodial needs, hose bibs, HVAC plant systems, and drinking water coolers/fountains. All municipal domestic

water entering the building must pass through a reduced pressure backflow preventer to protect the outside water source from contamination in the building. Whenever possible, the backflow device shall be located inside the building. A main pressure-reducing valve is required if the incoming water pressure exceeds 75 psi. All backflow prevention devices shall be installed and maintained in accordance with the requirements of the Arkansas Department of Health and/or the municipal water purveyor.

2. Water distribution throughout the facility will be through piping systems located above ceiling areas and below insulation. Piping installed under slab areas shall be avoided where possible, unless accessible for maintenance on the system.
3. Domestic water systems within the building shall be Type K or L copper tubing. The use of polyvinyl chloride, chlorinated polyvinyl chloride, or polybutylene material will not be permitted.
4. Water piping and gas piping to island sinks shall be in an accessible trench in the floor with a removable cover except in kitchens and for trap primers and shall be type K copper pipe.
5. The required pressure for operation of the furthest fixture from the incoming service will determine if a pressure booster system will be required. The booster system should be a packaged unit that includes all controls. Provide a constant-speed duplex pump package with bladder-type compression tank to meet the flow requirements. It will be necessary to consider the installation of an emergency power system in order to maintain the operation of the booster system in the event of power outages, if the building is to be used during emergency-type occupancies. Coordination with the Electrical Design Professional will be necessary.
6. Insulate the piping using fiberglass insulation to minimum requirements of current Arkansas Energy Code. Vapor barrier shall be maintained throughout piping system including all valves, hangers and terminations. Seal terminations with proper vapor barrier sealant.

Standards – Domestic Hot Water Systems

1. A hot water return system with a re-circulating pump shall be required if the building hot water piping is more than 100 feet in length.
2. The on/off operation of the 120 and 140 degrees Fahrenheit water circulation pumps shall be controlled by time clock operation and an aquastat.
3. Instantaneous water heaters with a storage tank shall be required for high use applications in buildings with kitchens and/or shower room facilities. Tank-type water heaters shall be considered for use in elementary school applications having no dishwasher facilities and no locker rooms.
4. The use of thermostatic mixing valves is required to maintain hot water temperature consistent with the plumbing code requirement of a maximum of 110 degrees Fahrenheit water to hand washing sinks and 120 degrees

Fahrenheit water to showers. Use a single valve or a high/low valve system based on minimum and maximum flow rates.
5. Provide a building-wide hot water system; instantaneous water heater for remote locations.

Standards - Water Conditioning and Softening Systems

1. The water shall be tested for quality to determine the makeup of the water including hardness, mineral content, and chemicals. The installation of a water conditioning/softening system shall be directly related to the results of the water testing. A total hardness of less than 10 grains will not require a softener system.
2. If the grain hardness is above 10 grains per gallon (171 ppm), the water softener shall be sized to reduce the hardness to 10 grains, but never below 6 grains. Soften the hot water only.

Complete Water Conditioning with Iron Filters

- Review with school personnel before incorporating water softening in the design. A complete water conditioning system, including iron filters, may be necessary in the event the water has high iron content from an on-site well system.

Standards – Sanitary Piping Systems

1. Piping materials shall include Schedule 40 polyvinyl chloride with solvent joints; cast iron no hub; or cast iron, hub and spigot. PVC piping in RA plenum is prohibited.
2. Fill material around piping below slab shall be compacted granular material to 95 percent-modified proctor. Piping shall not be installed parallel/directly under walls.
3. Piping above grade shall be cast iron, no hub with approved hanger spacing or schedule 40 PVC except in any plenum.
4. Acid waste piping below grade will be Schedule 40 polypropylene with fusion joints or lab grade CPVC with solvent cement joints. All acid waste piping above grade shall be Schedule 40 polypropylene with mechanical joints or lab grade CVPC with solvent cement joints. Acid waste piping in plenum applications shall be fire- and smoke-rated. Acid neutralizing sumps shall be located on the exterior of the building with access to grade.
5. Provide information to the Site Design Professional as to the depth of the sewer(s) exiting the building. Provide information to the Structural Design Professional as to the location and depths of the sewer in relationship to footings and columns as they pertain to the project.
6. Insulate sanitary sewer piping carrying HVAC system condensate.

Standards – Gas Piping Systems

1. Gas piping shall be Schedule 40 black steel with screw fittings for piping 2 inches or less and welded fittings for piping 2 1/2 inches or larger.
2. Gas piping in plenums shall not contain valves or unions.
3. A gas regulator shall be provided to maintain the correct inlet pressure to each gas appliance. The inlet and outlet piping to each regulator shall be valved with Arkansas Gas Code approved valves.
4. The maximum gas pressure into the building shall be as established by the local gas company. Provide the gas company with the gas load for each appliance, and the

minimum and maximum operating pressures for each appliance early in the design process.
5. Provide a valve, union, and a dirt leg at each appliance connection.
6. LP gas piping shall not be concealed.
7. Natural gas piping to island sinks shall be in an accessible trench in the floor with a removable cover.

Standards – Roof Drain and Storm Sewer Systems

1. Piping materials shall include Schedule 40 polyvinyl chloride with solvent joints; cast iron, no hub or cast iron, hub and spigot.
2. Fill material around piping below slab shall be compacted granular material to 95 percent-modified proctor. Piping shall not be installed parallel/directly under walls.
3. Piping above grade shall be cast iron, no hub, with approved hanger spacing.
4. Provide connections to all roof drains.
5. Provide information to the Site Design Professional as to the depth of the sewer(s) exiting the building. Provide information to the Structural Design Professional as to the location and depths of the sewer in relationship to footing and column pass as they pertain to the project.
6. Insulate the bottom of roof drains and branch lines from drain to downspout.
7. Insulate storm drain piping carrying HVAC condensate.

Standards – Food Service Areas Systems

1. Ware washing system will have a booster heater to provide 180-degree water unless the system utilizes a chemical dishwasher.
2. Provide 3-compartment sink with 110-degree water.
3. Provide a grease interceptor on the sanitary sewer line serving the food service area. The grease interceptor shall be located on the exterior of the building and will be sized for a 500-gallon minimum capacity, constructed of concrete or cast iron with access to grade. Interceptor shall meet the Arkansas Plumbing Code and Local requirements. Locate the interceptor as close to the building as practical.
4. Provide 140-degree water to all kitchen equipment except hand washing lavatories and sinks.

Standards – Building Fire Protection Systems

1. All buildings shall have a complete fire suppression (sprinkler) system throughout in accordance with NFPA 13, 14 and 20 when dictated by the design professional. Available static water pressure, residual pressure, and water flow must be evaluated as a part of this determination.
2. Installation of a water storage system along with the fire pump installation may be required where insufficient water, flow, and pressure are present.
3. A backflow preventer shall be included on all incoming systems.

Standards - Plumbing Fixtures and Specialties

1. Water closets shall be china, white, hand operated or battery or hardwired infrared flush valve, wall hung or floor mounted, and low water consumption type.
2. Urinals shall be china, white, hand operated or battery/ hardwired infrared flush valve, wall hung or floor mounted, and low water consumption type.
3. Lavatories shall be wall or counter mounted china and shall have cast brass hand operated or battery or hardwired infrared faucet. Temperature control shall be integral with the faucet or remote mixed (see Domestic Water Heater System Standards).
4. Showers shall be low water consumption, pressure-balanced type.
5. Drinking water coolers/fountains shall be refrigerated and conform to ADA standards.
6. Sinks shall be 18-gauge, 302 or 304 stainless steel
7. Science lab sinks shall be connected with acid-resistant material. The science casework manufacturer shall provide sinks.
8. Large group restrooms shall be provided with lavatories or a comparably sized wash fountain with infrared sensing or manual operation.
9. All plumbing fixtures and trim designed or designated for use by the handicapped shall meet the Americans with Disabilities Act guidelines.
10. Water supply (hot and/or cold) to the lavatories, sinks, and drinking fountains shall have angle stops with loose key handles.
11. All lavatories, water closets, and urinals shall have wall carriers.
12. Floor drains shall be installed in each restroom (except single person toilet room), locker room, mechanical room, and kitchen area. Provide a sediment bucket in the floor drain if conditions exist where solids may enter the drain.
13. Sanitary and storm sewer cleanouts shall be installed at 100 feet on center inside and outside the building, and at changes in direction of 90 degrees or more, at the bottom of vertical risers, and as the sewer exits the building.
14. Showers shall have a hot and cold, single lever pressure balancing valve with a vandal-resistant head.
15. Service sinks shall be floor-mounted, molded stone, 10 inches high, with a wall-mounted faucet, except as provided in Item 21.
16. Install a cold water hose bib in each large group restroom, locker room, and mechanical room if a hose bibb is not located within 40 feet of these areas. The hose bibb shall be surface mounted behind a lockable door in restrooms and locker rooms, with access by a removable key handle.
17. Reduced pressure backflow preventers are required on the water supplies to each HVAC makeup water system.
18. A water pressure reducing station requiring 2 pressure reducing valves sized for 1/3 and 2/3 flows shall maintain the water pressure in the building to a

Waterless Urinals

- Waterless urinals are optional.

maximum of 75 psi, if the incoming water pressure can exceed 75 psi.

19. Clay traps shall be provided in art rooms to prohibit clay and solids from entering the sanitary sewer. The clay trap shall be accessible to clean out the trap.
20. Trap primers or trap guards shall be required for all traps inside the building. Trap primers or trap guards shall be accessible for repair.
21. Provide floor drain sinks with hinged covers in custodial closets and the main mechanical room for emptying of the power floor cleaning units, where those devices are used.
22. Install exterior hose bibbs on all exterior faces of the building.

HVAC

Components – HVAC

- General
- System Selection Life Cycle Cost Analysis
- Outdoor Air Design Values
- Indoor Air Design Values
- Outdoor Air Ventilation
- Welding Ventilation
- Temperature Control Systems
- Ductwork
- HVAC Piping
- HVAC Insulation
- Interior and Exterior Noise Control
- Equipment Accessibility
- Closeout Documents
- Physical Education and Indoor Practice Facility

General Standards – HVAC

1. The heating, ventilating, and air conditioning system design standards criteria denoted as a part of this Facility Manual have been developed or are obtained directly from accepted engineering design references such as the ASHRAE handbooks and standards, the state of Arkansas code references, and good engineering practice. School HVAC system plans and specifications shall be prepared by a licensed professional engineer with a valid Arkansas registration. The HVAC Design Professional shall review each requirement and obtain or develop the necessary information for each specific building before proceeding with the systems design.
2. All systems shall be designed in compliance with ASHRAE Standard 90.1 "Energy Standard for Buildings except Low-Rise Residential Buildings", as modified by the Arkansas Energy Code.
3. All HVAC products shall be rated in accordance with the applicable ARI rating program (where rating has been established) or products manufactured in compliance with policies of the Arkansas HVACR Licensing Board and in compliance with Arkansas Law.
4. All new construction shall include air-conditioning except in some physical education and indoor practice facility spaces as hereinafter defined. Variances will be considered by the Division upon request.

Guidelines – HVAC System Selection Life Cycle Cost Analysis

- Several HVAC systems are applicable to Arkansas Schools. System selection should be based on a life cycle cost analysis of a minimum of three alternative systems. This requirement for System Selection Life Cycle Cost Analysis applies to New Construction, including new buildings and additions to existing buildings, and the replacement to upgrade HVAC units in existing buildings when the cumulative cooling tonnage exceeds 16 tons. The Life Cycle Cost Analysis should be submitted with the project final review documents. This analysis may be considered as an extra service to the design contract.

Guidelines – HVAC System Selection Life Cycle Cost Analysis (continued)

- The following are examples of acceptable programs for use in generating a detailed evaluation of proposed heating, ventilating, and air conditioning systems. Further, the building load calculations necessary for the design of each building will require the use of computer-generated data. Equivalent computer programs that are able to generate the necessary data for evaluation of the proposed heating, ventilating, and air conditioning systems and for generation of the building load data will be considered, but must be submitted for approval prior to use.
  - Trane Trace 700 (or the most recent version of Trane Trace)
    The Trane Trace 700 program is a PC based program used by the HVAC Design Professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained from the Trane Company, Customer Direct Service (CDS) Network, La Crosse, WI, (608) 787-3926.
  - Carrier HAP (or the most recent version of Carrier HAP)
    The Carrier Hourly Analysis Program is a PC based program used by the HVAC Design Professional for generation of detailed building system air conditioning loads, energy consumption analysis, and economic analysis. The current version can be obtained by contacting the local Carrier equipment representative or by calling (800) 253-1794.
  - DOE-2.E
    The DOE-2.E is a detailed energy analysis program developed through the United States Department of Energy. A number of vendors across the country have developed software that operates to meet the intent of the DOE-2.E program. Contact the Energy Science and Technology Software Center at (865) 576-2606.

Guidelines – HVAC System Selection Life Cycle Cost Analysis (continued)

- Occupancy loads and schedules will mirror the building usage schedules. Input occupancy should be calculated at 90 percent of capacity during normal school hours for classroom areas and the administration area. After hours occupancy can be considered negligible in these areas. Activity areas such as gymnasiums should be calculated at no more than 25 percent of the full load capacity during unoccupied operation.
- Lighting systems should be consistent throughout the building. The lighting load shall be input for consideration as a cooling load only, and should not be used to credit the winter heating load. Lighting loads should comply with the Arkansas Energy Code. The HVAC Design Professional should coordinate and review proposed lighting requirements for each building with the Electrical Design Professional prior to generating a final energy load analysis. Usage of the lighting systems should mirror the occupancy scheduling for each area in the building.
- Computer Locations and expected usage will impact every building designed. All classroom areas will be wired for computers. Include a minimum of 280 watts for each computer station in the building. This load includes the total expected heat gain for a desktop computer and color monitor.

Standards – HVAC Outdoor Air Ventilation

1. Outdoor ventilation rates shall be calculated for each occupied space and shall conform to the requirements of the Arkansas Mechanical Code minimum ventilation rates. The only exception will be an engineered ventilation system design with written approval of exception by the Arkansas HVACR Board.
2. Each system shall include controls for a 100 percent economizer cycle to cool the building when dictated by the Arkansas Energy Code.
3. Energy recovery shall be used as a part of the design for classroom, gymnasium, locker room, and student dining systems to reduce the energy consumption required to provide the necessary outdoor ventilation rates when required by the Arkansas Energy Code.
4. Carbon dioxide levels may be monitored through the direct digital temperature control system for proof of system operation to maintain a carbon dioxide level in the building as recommended by ASHRAE Standard 62. The use of space specific carbon dioxide sensors are

Guidelines – HVAC Outdoor Air Design Values

- Summer and winter outside air design values should be derived from standard ASHRAE compiled weather data located in the latest edition of the ASHRAE Fundamentals Handbook. The city nearest the proposed construction project is to be selected for evaluation. Use the 99.6 percent design values for heating design dry-bulb and the 1 percent design values for cooling design dry-bulb and mean coincidental wet- bulb. To determine the maximum ventilation capacity, use the 1 percent design values for Humidification design dew point and mean coincident dry bulb.

recommended for this operation. Return air sensors may be considered when a unit serves multiple spaces provided accurate readings can be obtained. It is not the intention of this paragraph to require the use of carbon dioxide sensors for a reduction of outside air quantities below the calculated minimum air flow requirements.

5. Ventilation air shall be conditioned for temperature and humidity control. Acceptable methods are dedicated OSA units, energy recovery ventilators, hot gas humidity control in packaged units and OSA conditioned in an air handling system. Untempered air shall not be introduced from exterior louvers into return air plenums or duct from the outdoors into the return air ductwork.

Guidelines – HVAC Indoor Air Design Values

- Indoor air temperature design values should reflect the need for energy conservation and should be in accordance with the Arkansas Mechanical Code and the Arkansas Energy Code.
- Design should produce indoor conditions in accordance with ASHRAE Standard 55 "Thermal Environmental Conditions for Human Occupancy."
- Night setback controls should be used for all systems. Temperature should be 55 degrees Fahrenheit. The summer setup temperature shall operate as required to maintain a relative humidity in the building area that does not exceed 60 percent. Maintaining humidity levels below 60 percent will result in periodic operation of the HVAC system during the summer months to reduce the potential for mold and mildew in the building.

Guidelines – HVAC Welding Ventilation

- Different ventilation strategies may be needed in each specific case to remove air contaminants from the welder's breathing zone. General guidelines have been published in CSA W117.2 Safety in Welding, Cutting, and Allied Processes, and ANSI Z49.1 Standard Safety in Welding and Cutting.
- Mechanical ventilation should be required when welding takes place in a space less than 10,000 cubic feet per welder, or in a room with a ceiling height of less than 16 feet. Mechanical ventilation should be at a rate of 2,000 cubic feet per minute per welder. See subsequent items below.

Guidelines - HVAC Welding Ventilation (continued)

- Dependent on the application and associated hazard, ventilation strategies fall into three general categories: Natural Dilution Ventilation, Mechanical Dilution Ventilation, and Local Exhaust Ventilation
- Night setback controls should be used for all systems
- Natural Dilution Ventilation involves introduction of fresh air into the welding area through non-mechanical mean such as opening windows and doors, and the use of exterior wall louvers. This type of ventilation is generally considered the least effective, since there is no control on movement of contaminants through the work area.
- Mechanical Dilution Ventilation involves the use of wall or roof exhaust fans to draw contaminants away from the welder's breathing zone
- Local Exhaust Ventilation involves the use of dedicated exhaust hoods or movable hoods to remove contaminants from the welder's breathing zone. Movable hoods are ducted to a central exhaust system and provide the best removal of contaminants. Local exhaust ventilation is always the preferred method for removing welding fumes and gases.
- Exhaust hoods should provide a minimum velocity of 100 feet per minute
- A downdraft exhaust bench is preferred over an overhead exhaust hood
- Exhaust air velocities higher than 100 feet per minute at the arc or flame may disturb the process or shielding gas.
- Obtain the services of an HVAC design professional for special cases and when welding materials that produce high toxicity levels

Standards - HVAC Temperature Control Systems

1. All temperature control systems installed shall be electronic, direct digital controls. Pneumatic control systems will not be permitted. Each facility will be provided with the means to access the control system software with a desktop or laptop computer. It will be necessary for the HVAC Design Professional to advise the school district of the options for control and management of the building available through the direct digital control

system. Building additions where less than 50% of the square footage is being added to a school campus without a DDC system may utilize 7-day programmable thermostats.
2. Thermostatic zoning shall be developed using good engineering practice. Dissimilar spaces shall not be grouped on the same thermostat. Each classroom shall be an independent zone. Other zones may also be required to be separately thermostatically controlled. Carefully review space requirements for these requirements. Occupied/unoccupied scheduling shall be based on the associated air handling system. Each thermostat zone associated with digital control shall have a means to override the schedule for temporary occupancy.
3. The direct digital control system shall be capable of performing time of day scheduling, night set-back, holiday scheduling and demand limiting.
4. The ventilation system control shall be set through the central direct digital controller based on global outside air temperature and humidity to maintain indoor relative humidity below 60 percent.
5. The direct digital control system shall be designed to place emergency calls to designated school personnel in the event of equipment failure.
6. Options shall be investigated with each direct digital control system for the operation of exterior, corridor, and restroom lighting systems through the energy management computer.

Standards – HVAC Ductwork

1. Duct systems shall be designed, constructed, and installed to provide minimum leakage and air noise, and to minimize system static pressure requirements. Design HVAC professional shall comply with SMACNA standards for construction and leakage standards.
2. Classrooms and other instructional spaces shall be ducted for supply to at least four (4) supply air devices
3. Ductwork shall be 26 gauge minimum
4. Flexible duct shall be rated ETL Class 1 Air Duct, complying to UL 181, with a maximum vapor barrier permeance of 0.05 Perm as measured by ASTM E96, Procedure A
5. Flex duct shall be limited to 6’ in length

Standards – HVAC Piping

1. Hydronic piping 2” and below shall be type L copper piping.
2. Hydronic piping 2 ½” and above shall be schedule 40 steel with welded fittings.
3. HVAC condensate piping shall be type M or L copper piping.
4. Refrigerant piping shall be ACR copper tubing.

Standards – HVAC Insulation

1. Hydronic piping and condensate piping insulation shall be jacketed fiberglass insulation with vapor barrier and preformed fittings per the latest adopted version of the Arkansas Energy code for HVAC.

2. Duct insulation shall be FRK duct wrap and a minimum of 1 ½" with a density of .75 lbs/cf.
3. ACR piping insulation shall be closed cell elastomeric insulation with non-longitudinal seams and butt connection sealant. Provide adequate UV protection for outdoor applications.
4. Maintain vapor barrier throughout the system including hangers, joints and terminations.

Standards – HVAC Interior and Exterior Noise Control

1. The location of exterior mechanical equipment shall be reviewed by the Design Professional for its sound impact, both inside and outside the building.
2. Exterior equipment operation shall not cause indoor sound levels to exceed specified levels for the space.
3. Exterior sound levels shall be in compliance with the local governmental ordinances. When these values are not governed, the sound level created by the equipment shall not exceed 70 dB measured at the property line.

Guidelines – HVAC Interior and Exterior Noise Control

- Interior HVAC acoustic design should not cause indoor sound levels to exceed NC30

Standard – HVAC Equipment Accessibility

1. Access and service space per mechanical equipment shall be in accordance with the Arkansas Mechanical Code.

Standard – HVAC Closeout Documentation

1. The contractor and/or engineer shall provide to the School District an accurate set of as-built plans, showing all construction revisions to the design set.

Guidelines – HVAC Closeout Documentation

- O & M Manuals should be provided in duplicate for the School District
- Manuals should contain approved shop drawings, operations and maintenance instructions and parts manuals for all HVAC equipment

Standards – HVAC Physical Education and Indoor Practice Facility

1. Indoor Practice Facilities shall be heated and ventilated
2. Ventilation systems must provide ten air changes per hour in spectator facilities
3. Ventilation systems must provide five changes per hour in non-spectator spaces
4. The ventilation must provide intake air near playing floor level and exhaust air at the opposite high wall of the space

Guidelines – HVAC Physical Education and Indoor Practice Facility

- Gymnasiums may be heated and ventilated rather than being provided with mechanical cooling when the HVAC systems are effectively separated from other areas of the building
- Ancillary spaces such as offices and locker rooms should be served by separate HVAC systems

Electric

Components – Electric

- Energy Usage
- Distribution
- Lighting
- Wiring Devices
- Fire Alarm Systems
- Security Systems
- Lightning Protection
- Technology
- Telecommunications Grounding
- Intercom / Bell Systems

Standards – Energy Usage - Electric

1. All systems shall be designed in compliance with the latest version of ASHRAE Standard 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings," and the energy usage requirements prescribed by the latest Arkansas adopted version of the Arkansas Energy Code and the Department of Energy.
2. All electrical work shall be in compliance with the latest edition of the National Electrical Code (NEC) as adopted by the State of Arkansas.

Guidelines – Energy Usage - Electric

- Consideration should be given to provide a metering device to measure all electrical usage for new buildings over 6,000 SF

Standards – Electric Distribution

1. Electrical systems distributed throughout the building shall be based upon the 480-volt or 208-volt, three-phase, grounded wye configuration except electrical system extensions in existing buildings, which may match existing criteria where not economically feasible to reconfigure. All attempts shall be made to rectify potentially dangerous voltage configurations.
2. Transient voltage surge protection and lightning arrester devices shall be located on main service distribution equipment.
3. Current carrying conductors shall be a minimum No. 12 American Wire Gauge (AWG), except for systems wiring such as fire alarm, data, telephone, etc. Conductors shall only be copper except aluminum conductors which may be utilized in lieu of copper conductors for wire size 4/0 AWG and larger. Terminations must be listed compression connectors using a compatible oxide inhibitor. A School District shall put in place and submit to the Division a maintenance plan for annual review of all terminations by qualified personnel. Conductor size No. 12 AWG and No. 10 AWG must be solid type, except where flexibility is required, such as at motors. Conductors larger than No. 10 shall be stranded. Aluminum lugs for terminating copper conductors are acceptable, if labeled for that purpose.

4. Current carrying conductors shall be installed in conduit systems conforming to the NEC, latest edition adopted by the State.
5. Continuous equipment grounding conductors shall be installed in all circuits bonded to all ground lugs, bussing, switches, receptacles, equipment frames, etc., per the NEC. The main facility grounding field electrode system to ground shall be 5 ohms or less.
6. Electrical systems main service equipment shall be designed with a minimum 25 percent spare amperage capacity and 20 percent spare space capacity. Panel board loads shall not exceed 75 percent of amperage capacity and each panel shall be provided with a minimum of 6 spare overcurrent protection devices. Provide spare overcurrent protection devices in branch distribution panel boards and main service equipment boards.
7. Electrical energy distribution equipment shall be located in dedicated electrical or mechanical rooms, and mounted at heights in accordance with the "Device Locations" table at the end of this Section 7400. Main electrical service (switchboards) distribution equipment shall not be located in the main heating or cooling generating room. Branch circuit panel boards recessed in corridor walls will not be acceptable. Provide exterior lockable Main Disconnecting means.
8. Coordinate service entrance requirements with local utility service companies for electrical energy, telephone, and cable television.
9. Dry type transformers shall be National Electrical Manufacturers Association (NEMA) TP-1/TP-2 compliant energy efficient type. Dry type transformers shall be floor mounted.
10. Electrical branch circuits to 5 horsepower, 3-phase, and larger motors for air-handling units, exhaust fans, pumps, chillers, and condensing units shall be provided with phase loss protection. Protection shall prevent equipment from single phasing. Phase loss protection equipment shall be integral to starters or variable frequency drives serving the equipment.
11. Voltage drop for feeders between the service entrance equipment and the branch circuit distribution equipment shall conform to the requirements found in the latest State adopted version of the NEC.
12. The intent of connecting emergency power to selected components of the HVAC system is to provide an opportunity to limit damage from freezing weather during a power outage of short duration. The following components are not required to be connected to the emergency power source and are optional within budgets:
    - Air handling unit pre-heat coil (heating coil)
    - Cooling tower basin heaters
    - Chilled water circulating pump, when used for chiller freeze protection
13. Independent, separate raceway, wiring, and transfer switches shall be provided for emergency life safety systems and non-emergency life safety systems.
14. Run all branch circuit and feeder conduits within buildings above ceilings and within walls unless stated below. No

device conduits are permitted in or below slabs unless serving a device or millwork that requires it. Below slab conduit may be used from MDP to the secondary panels only. Conduit shall be ¾" minimum trade size. MC cable may be used for "lighting whips" of lengths less than 6'0". EMT conduit should be used within walls and above ceilings to ease future circuit and technology upgrades.

15. PVC conduit is not allowed except for the underground portion of the incoming utility service to the buildings. It must then be encased in 3" of concrete. All elbows and risers to 6" above finished floor in PVC conduit runs must be rigid steel. PVC elbows are not allowed.
16. MC cable is not allowed for use in walls to devices.

Standards – Lighting

1. Interior instructional spaces shall be artificially illuminated with energy-efficient and high-efficiency light fixtures.
2. High volume spaces such as gymnasiums, student dining, etc., shall be illuminated with high-efficiency, high-intensity discharge lamp type light fixtures; or, an equal or better energy efficient fluorescent luminaire that maintains or increases light levels. Fluorescent luminaires which are at least as efficient as high- intensity discharge fixtures are recommended over seating areas. Quartz restrike options shall be incorporated into some fixtures to provide an average of 2 foot-candles of illumination during the cool- down/warm-up (restrike) period caused by momentary electrical outages.
3. The minimum illumination (foot-candle) levels shall conform to the established Illuminating Engineers Society of North America (IES) guidelines. See the "School Lighting Levels" chart at the end of this Section 7400. Foot-candle calculation shall be developed by using computerized point-by-point analysis of classrooms and other learning spaces. Ceiling, wall, and floor material reflectances shall be verified with the Electrical Design Professional.
4. Emergency means of egress lighting shall be provided per local and NFPA Code requirements. The following areas shall have emergency illumination whether having natural illumination or not:
   - Exits and exit access corridors
   - Small and large assembly areas
   - Locker rooms
   - Student restrooms
   - Main and other dedicated electrical rooms
   - Main mechanical room and other mechanical decks
   - Emergency power equipment location
   - Administration and other building control areas
   - Kitchen/student dining
   - Interior instructional space
   - Rooms with occupant load over 50 people
   - Exterior side of exterior exit doors

   Where the total emergency power load exceeds 8 kW, emergency power shall be delivered by on-site, standby power generator. Generators rated 150 kW and below

shall use gaseous fuel (if available, large units shall be diesel).

5. Light fixtures shall be controlled by switches on a per room basis where fixtures are located. Circuit breakers will not be acceptable for turning lighting "on" and "off". Switches are to be installed in accordance with "Device Locations" table at the end of this Section 7400.
6. Exterior parking areas shall be illuminated with high-intensity, discharge lamp type light fixtures. Do not use high pressure sodium or mercury vapor. Fluorescents or LED lighting shall be used.
7. Computer labs shall be illuminated with fluorescent light fixtures constructed and configured to reduce glare on computer monitors. Minimum Visual Comfort Probability (VCP) in these rooms shall be 80%.
8. Fluorescent lighting in instructional spaces shall be oriented so the long dimension of the fixture is parallel with the chalkboard on the primary instructional wall and switched separately unless design parameters suggest otherwise. Optionally provide wall wash type fixtures to illuminate white-boards or chalk-boards.
9. Provide site lighting to foot-candle levels recommended by the IES.
10. Light fixtures located in gymnasiums and auxiliary gymnasiums shall be equipped with protective wire guards.
11. Exit signs shall be wall mounted, where possible, in lieu of ceiling mounted and be of the LED type.
12. Middle School and High School Art rooms shall be provided with supplemental track lighting that comes as close as possible to the color and quality of daylight, generally in the color temperature range of approximately 5000 Kelvin to 5900 Kelvin.
13. Walk through fluorescent lighting shall be provided to supplement main lighting in gymnasium and auxiliary gymnasiums to illuminate area to 5 foot-candles. Fixtures shall be vandal-resistant type and protected with wire guards. Mount fixture at same level as high intensity discharge lighting. LED or fluorescent lighting shall be used.
14. Options shall be investigated for control of exterior and interior corridor lighting by direct digital control, the energy management system, or occupancy sensors.
15. Interior lighting shall be controlled by occupancy sensors, automatic timed lighting controlled system or a combination of both to comply with ASHRAE 90.1 as required by the Arkansas Energy Code. Exterior lighting shall be controlled by photo sensor or astronomical time clock to comply with ASHRAE 90.1 1 as required by the Arkansas Energy Code to automatically turn lighting off when sufficient daylight is available.
16. Instructional space lighting shall be configured to provide at least two levels of light. One level shall be configured to darken the area around a video or projection screen.
17. Options shall be investigated for providing non-disruptive day-light harvesting in classrooms and other spaces with natural lighting.

Standards – Wiring Devices –Electric

1. Receptacles, switches, and other wiring devices to be installed at heights above finished floor in accordance with the "Device Locations" table at the end of this Section 7400.
2. General purpose use, 120-volt duplex receptacles shall be specification grade, 20 amp standard grounded type.
3. Separate receptacles located within instructional spaces shall be provided for general purpose uses and for computer/video technologies.
4. Instructional spaces shall be provided with a minimum of 8 general use receptacles, as well as double duplex receptacles next to computer/video technologies ports.
5. Each space or room shall be provided with a minimum of one, 120- volt receptacle.
6. General purpose receptacles in corridors shall be spaced a maximum of 50 feet apart and not on classroom circuits.
7. Office areas, conference rooms, and teacher workrooms shall be provided with a minimum of 4 receptacles..
8. Duplex receptacles within 6 feet of plumbing fixture units shall be ground fault protected. These receptacles shall be protected by a local or an integral ground fault device.
9. A maximum of 4 computers shall be on a single 20-amp, 120-volt electrical circuit with a dedicated ground, and neutral. Do not share computer circuit neutrals with other branch circuits.
10. Key-type switches protected with wire guards shall be used to control lighting in gymnasiums, auxiliary gymnasiums, and locker rooms. Non-protected key switches shall be used to control lighting in corridors, large group restrooms, and other public spaces. Instructional type spaces shall be controlled by toggle-type switches.
11. Provide an exterior, weatherproof ground fault protected duplex receptacle outside each main exterior door.
12. Electrical receptacles serving food service equipment not located against walls shall be mounted above the floor line on pedestal-type mountings.
13. Kindergarten classrooms and their auxiliary spaces shall have duplex, tamper-resistant receptacles installed.
14. Receptacles shall be side-wired using pigtails. Back-wiring or thru- wiring on device terminals is not acceptable.
15. A dedicated 20 amp charging station shall be installed per every eight instructional spaces.

Standards – Fire Alarm Systems

1. Fire alarm and fire protection systems shall be installed per the Fire Prevention Code and NFPA 70. System device mounting heights above finished floor provided in the table "Outlet Locations" at the end of this Section 7400.
2. Companies designing, installing or servicing fire alarm systems in Group E occupancies shall be properly licensed by the Arkansas Board of Private Investigators, Private Security Agencies and Alarm Systems Companies.
3. Fire alarm shop drawings shall be prepared in accordance with the Arkansas Fire Prevention Code and approved by the State Fire Marshal's office or their Designee prior to installation.

4. Main control panel shall be located in the administrative area.
5. A Sequence of Operation document shall be provided to the District with each system.

Standards – Security Systems

1. Within the base building electrical system cost, provide the following basic security systems:
   - Provide conduit rough-in and wiring only for key pad locations, motion sensors, door contacts switches, card readers, and control panel
   - System selection, installation and funding shall be by the school district
   - A minimum system design shall include door contact switches at exterior doors, and motion detectors distributed throughout corridors, administrative areas, and in rooms with 6 computers or more

Standards – Lightning Protection

1. Within the design of the base building electrical system, the Electrical Design Professional has the option of including an Underwriter's Laboratory (UL) listed and certified lightning protection system, where calculations indicate the facility may be at elevated risk. Therefore, where calculations indicate the facility may be at an elevated risk, new school buildings shall be protected but additions to existing schools with no history of damage with similar roof elevations may be omitted.

Standards – Technology

1. Within the base building electrical system cost, provide the Technology rough-ins required by this sub-section. Coordinate the placement of all Technology Conduits, boxes and outlets with the Technology Design Professional.
2. Provide Telecommunications cable tray above corridor ceilings of academic wings. Cable tray depth shall be calculated per NEC requirements.
   - Provide 24" center-hung raceway in main corridors
   - Provide 18" center-hung raceway in secondary corridors
   - Cable tray shall connect between all intermediate closets Telecommunication Rooms (TRs) and the Main Cross- connect (MC)
   - Provide continuous bonding conductor (minimum # No.6 AWG), in accordance with NEC-250 and TIA/EIA-607-B, in all cable trays and bond to associated Telecommunications Grounding Busbar (TGB)
   - NOTE: Cable "D" devices may be used in lieu of cable trays in both main and secondary corridors, providing they are of sufficient size to clearly distinguish individual runs. J-Hooks shall be pre-galvanized, with a static load capacity of 30 lbs., and cable retainers.
   - All firewall penetrations shall be appropriately and properly sealed per latest state adopted version of the NFPA

3. Junction boxes used for data/voice/video outlets shall be 2-gang, 3 1/2:" deep boxes and equipped with a minimum of a 1" conduit home run to the associated Telecommunications Cable Tray, except where noted by the Telecommunications Design Professional.
4. Telecommunications Rooms (TRs) shall be provided with a minimum of two (2) 120-volt, 30 Amp circuits for powering rack mounted UPS Units. Each receptacle used for powering UPS units shall be twist lock. Quantity and location of circuits will depend upon requirements of Technology Design professional. If the building has a standby Generator, these circuits shall be attached to the standby power. General use receptacles, as well as double duplex receptacles shall be provided next to computer/video technologies ports.
5. In concert with the "Device Locations" table at the end of this Section 7400, provide power outlets, technology cabling home-run conduits and projector mounting brackets as follows:
    - Provide one (1), 2-gang, 3-1/2" deep box for Technology use (HI station) and a quad power outlet mounted at 18" below finished ceiling for monitors installed in wall or ceiling mounts
        - Provide one (1), home run, 1-1/4" conduit from HI Station box to associated instructor LO Station box
        - Provide one (1), home run, 1" conduit from HI Station box to associated Telecommunications Cable Tray
    - Provide one (1), 2-gang, 3½" deep box for the instructor's LO station and quad power outlet at 18" AFF
        - Provide one (1), 1-1/4" conduit from LO Station box to associated monitor HI Station box
    - For locations with an Overhead Mounted Projector in lieu of a Monitor, provide one (1), 1-gang, 3-1/2" deep box for Technology use (Projector HI station) and a dual power outlet mounted in a finished ceiling tile, projector bracket in the finished ceiling
        - Provide one (1), 1-1/4" conduit from Projector HI Station box to associated instructor LO Station box
        - Provide one (1), home run, 1" conduit from Projector HI Station box to associated Telecommunications Cable Tray
6. Provide a minimum 4-3/4 inch high center divided surface applied metal raceway in computer labs where equipment is located on perimeter of room.
        - Provide one (1), 1-1/4" conduit for every six computer workstation locations stubbed up above the nearest finished ceiling and home run to the Telecommunications cable tray
7. Provide two (2), 2-gang, 3½" deep boxes for the video projector local inputs, with one on the backside of the proscenium wall and one in the control booth.
        - Provide one (1) home run 1½" conduit from each box to the video projector in the ceiling. Provide a minimum of one 4" conduit for Wide Area Network

(WAN) from the Service Provider (SP) Entrance (DEMARC) to the property line.

8. Provide a minimum of one 4" conduit for Wide Area Network (WAN) from the Service Provider (SP) Entrance (DEMARC) to the property line.
9. Provide one (1), 4" conduit for cable television (CATV) from the Service Provider (SP) Entrance (DEMARC) to the property line.
10. Provide one (1), 4" conduit for the telephone from the Services Provider (SP) Entrance (DEMARC) to the property line.
11. Provide a minimum of two (2), 4" conduits from the Service Provider Entrance (DEMARC) to the Main Cross-Connect (MC) Telecommunications Room (TR). Conduit runs for fiber optic cable have no more than two (2) 90 degree bends without installations of a pull box. All 90 degree bends are to be wide sweep. Pull boxes should be placed in a straight section of conduit and shall not be used in lieu of a bend. Pull box sizing shall be in accordance with TIA-569-C.
12. Provide two (2), 2" sleeves in all classroom walls.
13. All empty conduits shall be provided with a rot, mildew, and tangle resistant pull string.
14. Exterior conduit shall not exceed 600 feet between pull points and shall not contain more than two (2) 90 degree bends. Covers shall be rated per application.
15. Ground floor outlet boxes shall be rated for damp locations with a direct pathway provided under slab to the nearest telecommunications room. All telecommunications copper cabling located under slab shall be OSP rated.
16. Generic telecommunications cabling shall be installed in a hierarchal star topology.

Standards – Telecommunications Grounding

1. Provide Telecommunications Grounding/Bonding System in accordance with NEC-250 and TIA/EIA-607 using Designer approved Grounding Hardware. CAD Weld Bonding Conductors to Building Steel.
2. Provide Telecommunications Main Grounding Busbar (TMGB) in the main cross-connect, and a Grounding Busbar (TGB) in the Telecommunications Rooms (TR).
   - All TMGB and TGB Connections to be made with double- bolted, Compression style, Grounding Lugs, as a minimum. Bond TMGB to following:
     - Building Steel (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
     - Main Electrical Service Ground (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
     - Local Service Panel Ground (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
     - Telecommunications Bonding Backbone (TBB) that connects TMGB to other TGBs (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B

- Associated Telecommunications Cable Tray(s) (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B
- Telecommunications Conduit(s) Entering TR (minimum No. 6 AWG insulated copper bonding conductor). Sizing per TIA-607-B

3. Provide Telecommunications Bonding Backbone (TBB) between all TGBs and the TMGB
   - The TBB shall be a minimum of No. 2 AWG insulated copper bonding conductor. Sizing per TIA-607-B
   - All TBB Connections to be made with double-bolted, Compression style, Grounding Lugs
4. As a minimum, the Technology Contractor shall bond the following devices to the associated TMGB and TGBs using a minimum No. 6 AWG (sizing per TIA-607-B) insulated copper bonding conductor using compression style lugs:
   - PABX equipment
   - Equipment racks and cabinets
   - TR cable ladder and tray
   - CATV Equipment
   - Lightning and surge protectors
   - Telecommunications devices
   - Coupled Bonding Conductors (CBCs)
   - Backbone cable shields
   - Telecommunication and fiber cable shields
   - Antenna cable shields
   - Raised floors

Standards – Intercom / Bell Systems

1. Provide a complete intercom communication system with call stations and speakers in each occupied space and speakers on the building exterior. Speakers shall be located and sufficiently powered to be clearly heard.
2. The intercom system shall be capable of generating various tone signals to be used in special notification situations.
3. Provide Battery Back-up for operation during a power failure.

School Lighting Levels - 2004

ROOM TYPE CLASSIFICATION	2000 IES FOOTCANDLES	RECOMMENDED DESIGN FOOTCANDLES DIRECT LIGHTING(1)	RECOMMENDED DESIGN FOOTCANDLES INDIRECT LIGHTING
ADMINISTRATIVE			
Offices/Receptionist	50	50	40
Storage Rooms	-	25	25
Restrooms	5	25-30	25-30
Conference/Resource Rooms	30-100	50	40
Health Clinic	50	50	40
Teacher Prep/Workroom	50	50	40
CLASSROOMS-GENERAL	30	50	40
Art Rooms/Kiln	50	50	40
Modular Technology Labs	-	50	40
CADD Labs	30	30	30
Industrial Tech/Production Labs	100	60	60
Computer Labs	30	40	40
Graphics Labs	30-100	50	40
Life Skills Labs	50	50	50
Science Labs	50	50	50
Laundry Rooms	-	25	25
Music Rooms	30-50	50	40
Large Group Instruction Rooms	30	50	40
MEDIA CENTER	-	50	40
Active Areas	30 vertical	50	40
Inactive Areas	5 vertical	40	40
ATHLETIC AREAS			
Gymnasium - Elementary School	100	50	-
Gymnasium - Middle School	100	50	-
Gymnasium - High School	100	60	-
Multi-use P.E. Rooms	-	50	-
Locker Rooms	10	25	25
STUDENT DINING			
Assembly	10-20	20	-
Stage/Work Lights	30	20	-
Make-up/Dressing Rooms	30-50	50	-
Theatrical Control Room	10-30	30	-
Equipment room with dimmable incandescent lighting offering 10 foot-candles of illumination.			

School Lighting Levels - 2004

ROOM TYPE CLASSIFICATION	2000 IES FOOTCANDLES	RECOMMENDED DESIGN FOOTCANDLES DIRECT LIGHTING(1)	RECOMMENDED DESIGN FOOTCANDLES INDIRECT LIGHTING
STUDENT DINING	10-50	50	40
Cooking	50	75-80 (2)	-
Food Preparation	50	75-80 (2)	-
Serving Line	50	75-80 (2)	-
Ware Washing	10	75-80 (2)	-
CUSTODIAL CLOSETS	10-30	20-30	-
ELECTRICAL ROOMS	30	20-30	-
MECHANICAL ROOMS	30	30	-
PARKING AREA	.2	(1 (3)	-
DRIVEWAYS	.3	.5 (3)	-
CIRCULATION AREAS			
Building Entries	5	5-10 (3)	-
Corridors	5	20	20
Corridors with Lockers	5	20	20
Stairways	5	20	20
(1) Maintenance factor 70% LL/SF = Lamp Lumens per square foot			
(2) Foot-candles shall comply with local health department regulations			
(3) Foot-candles shall conform to Sub-section 4200			

Recommended Device Locations

ELECTRICAL OUTLET DEVICE TYPE	Masonry Wall, Base (Starter) Course Height 4 inch Mounting Height Above Floor to Bottom of Outlet (Device) Box	Masonry Wall, Base (Starter) Course Height 8 inch Mounting Height Above Floor to Bottom of Outlet (Device) Box
Receptacle outlets, microphone outlets (jacks), equipment outlets (jacks), television outlets (jacks), portable telephone outlets, computer outlets, etc.		
* General throughout	18"	18"
* Mechanical equipment rooms	52"	48"
* Above counter tops 30"H	36"	40"
36"H	44"	48"
48"H	52"	56"
* Above backsplash top	2" minimum	2" minimum
* Above radiators	6" minimum	6" minimum
* Above or adjacent to lavatories	44"	48"
* Behind domestic refrigerators	52"	56"
* Behind domestic washers and dryers	36"	32"
* Serving domestic dishwashers	2"	2"
* Wall-mounted telephone outlets	44"	48"
* Telephone/video control	44"	48"
Toggle switches	48"	48"
Recessed motor controllers	60"	56"
Electric panels, terminal cabinets, etc., to center of tub or box	50"	48"
Clocks	Near ceiling	Near ceiling
Pull stations (fire alarm)	44"	44"
Volume controls, call-in switches, doorbell buttons	44"	44"
Horn/strobes (fire alarm)	80"	80"

Technology Systems

Components – Technology Systems

- General
- Technology Wiring
- Telecommunications Room Wiring
- Telecommunications Room Interior Environment
- Telecommunications Room Terminations
- Building Technology Wiring
- Telephone Systems
- Data/Communications Network
- Central Sound System/Public Address System
- Gymnasium Sound Reinforcement System
- High School Student Dining Area Sound Reinforcement System
- Student Dining Sound Reinforcement Systems (Cafetoriums only)
- Music Room Sound Reinforcement Systems
- Security Systems (optional)
- Interactive Classroom Design (optional)

Standards – General – Technology Systems

1. A Technology System Plan and Specifications shall be prepared in accordance with the latest edition of the Building Industry Consulting Service International (BICSI) Telecommunications Distribution Methods Manual (TDMM).
2. All work shall be performed in accordance with the latest revisions of the following standards and codes:
   - State Building Code
   - Local Building Code
   - Local Electrical Code
   - National Electrical Code
   - EIA/TIA-568-C Commercial Building Wiring Standards
   - EIA/TIA-569-C Commercial Building Standard for Telecommunication Pathways and Spaces
   - TIA 606-B Telecommunications Administration Labeling Standard
   - EIA/TIA J-STD-607-B Commercial Building Grounding/Bonding Requirements Standard
3. A Technology System Plan shall consist of the following minimum Telecommunications Drawings, as required:
   - Campus or Site Plans, Exterior Pathways, and Inter-Building Backbones
     - Shows physical and logical connections from the perspective of an entire campus - such as actual building locations, exterior pathways, inter-building backbone cabling on plan view drawings, and major system nodes and related connections on the logical system drawings.
   - Layout of complete building per floor – Serving Zone Boundaries, Backbone Systems, and Horizontal Pathways

Guidelines - Technology System

- The Technology System Plan and Specifications should be designed and approved by a Registered Communications Distribution Designer (RCDD).

    - The drawings should show the complete building layout per floor and indicate location of serving zones, communication equipment rooms, access points, pathways, and other systems that need to be viewed from the complete building perspective.
  - Serving Zone Drawings – Drop Locations and Cable IDs
    - The building is divided up by its serving zones. Drawings to indicate drop locations, communication equipment rooms, access points and detail callouts for communication equipment rooms and other congested areas. All telecommunications labeling shall be in accordance with TIA-606-B.
  - Communication Equipment Rooms – Plan Views – Tech and AMEP/Elevations – Racks and Wall Elevation
    - Detailed look at communication equipment room. Drawings should indicate technology layout (racks, ladder-racks, etc.), mechanical/electrical layout, rack elevation, and backboard elevation.
4. The Technology Design shall include the following components:
  - Mandatory Systems
    - Telephone system
    - Continuity of Operations Plan
    - Data / computer network system
    - Central sound / public address system
    - Gymnasium sound reinforcement system
    - High school student dining sound reinforcement system
    - Student dining sound reinforcement system
    - Music room sound reinforcement system
5. The Technology Designer should endeavor to reduce the quantity of Main Cross-Connect Rooms (MCs) by centralizing the MCs and/or using one MC to serve multiple floors or areas. For example, in a 3-story building, place the MC on the second floor and serve the 1st, 2nd, and 3rd floors from the same closet. The Technology Designer shall coordinate the quantity and size of MCs required with the design professional.
6. The Technology Designer should endeavor to centralize as many Technology and Control Systems as possible for the district into one school building or Network Operations Center (NOC), and interconnect the buildings and systems via fiber-optic cables whenever economically feasible. Consider using the savings from the centralization of the systems to offset the cost of the inter-building, fiber-optic cabling.

Guidelines - Technology – Optional System
- The Technology Design may (optional) include a Security System.

Standards – Technology Wiring

1. Media Standards
  - Unshielded twisted pair
    - The minimum standard for horizontal distribution wiring is six (6) cables of category 5e or higher, 4- pair, 24-gauge unshielded twisted pair (UTP) wiring, terminated in each classroom. The standard specifies 100-ohms impedance at one (1) megahertz, satisfying Integrated Services Digital Network (ISDN) and Institute of Electrical and

Electronics Engineers (IEEE) 802.3 10BaseT requirements.

- Fiber Optics
  - The media standard for both intra- and inter-building backbones is OM2 50/125 micron graded-index multimode optical fiber cable. A minimum of ten fiber strand cable should be installed for each cable run.
  - Grade of optical fiber cable shall increase based on distance anticipated bandwidth requirements. All optical fiber located outside or in a wet location shall be OSP rated, loose tube construction, and shall comply with ICEA S-87-640 for mechanical properties. Exposed OSP rated cable shall not exceed 50 feet within the building.
- Cross-connect jumpers and patch cables shall be of the same performance or greater and shall be factory manufactured modular cords.
- Comply with NEC and TIA-569-C for separating unshielded copper telecommunications cable from potential EMI sources.
- Install plenum rated cable in environmental air spaces, including plenum ceilings.

Guidelines – Technology Wiring

Media wiring specifications are a minimum of category 5e. When bandwidth is expected to be above category 5e of 1 Gigabit per second (Gb/s or 100 Mhz) then category 6 or 6A for up to 10 Gigabit or 200+ Mhz should be used. From a future proofing perspective, it is always better to install the best cabling available. This is because it is so difficult to replace cabling inside walls, in ducts under floors and other difficult places to access. The rationale is that cabling will last at least 10 years and will support at least four to five generations of equipment during that time. If future equipment running at much higher data rates requires better cabling, it will be very expensive at that later time to pull out category 5e cabling and to install category 6 or 6A cabling. Category 6 250 Mhz minimum is recommended.

Guidelines - Telecommunication Room Wiring

- A telecommunication room (TR) is a local communications equipment room. This should be a dedicated room providing a secure environment for the installation and termination of cable network electronics and other telecommunications equipment, *as specified in the ADE IT Security Policy (ISTP), 2B2*.
- The main cross-connect (MC), the point where the backbones and horizontal distribution facilities intersect, should be located near the center of the area served, preferably in the building core area. Every effort should be made to secure as large an area as possible. When one MC is insufficient to cover a building, additional TRs must be established. The same parameters apply for both TRs and MCs.
- Locate telecommunication rooms *away* from any sources of electromagnetic interference, such as electrical power-supply transformers, motors, and generators. There should be *no water sources* in this area.
- There should be one telecommunications room for each 20,000 square feet zone/wing/building section. The recommended minimum closet size is 8 feet by 9 feet. Closets should be designed with adequate conduit or openings through beams and other obstructions into the accessible ceiling space. Closets should be designed with controls to limit access to authorized personnel only, *as specified in the ADE IT Security Policy (ITSP), 2B2*.
- The MC contains wiring terminations and communications equipment to serve a building. This equipment may include modular fiber distribution panels, wiring termination panels, telephone systems, concentrators/hubs that connect communication lines, routers that connect users on different networks, CATV (cable television) equipment, and equipment racks.

Standards – Telecommunication Room Interior Environment

- Telecommunication rooms require continuous climate control. Air conditioning should maintain temperature in the range of 65 to 75 degrees Fahrenheit, with relative humidity in the range of 40 to 55 percent. Telecommunication rooms require continuous climate control. The temperature and humidity in telecommunication rooms shall meet the requirements for ASHRAE Class B.
- Tile or sealed concrete floors will protect equipment from static electricity and dust.

Standards – Telecommunications Room Terminations

1. Racks must be grounded in accordance with National Electrical Code (NEC) requirements and TIA-607-B. Rack fill shall be in accordance with NEC requirements. Minimum rack clearance requirements shall be a minimum of 3 feet front clearance and 2 feet rear clearance.
2. Terminate the fiber optic cable with ST, SC, LC or pre-terminated high capacity MPO type connectors. The maximum optical attenuation for each mated connector pair must not exceed the connector manufacturer's specifications.
3. Terminate category 5e or higher cable on category 5e or higher RJ45 patch panels in all closet locations.

Standards – Building Technology Wiring

1. Student Workstation Wiring

- Run two cables of category 5e or higher, 4-pair, unshielded twisted pair from each student workstation outlet to the wiring patch panel located in the telecommunication room. The cables must be a *continuous run* and not spliced. The maximum cable length must not exceed 295 feet/90 meters as specified in the EIA/TIA-568-C commercial building wiring standard. The maximum allowable horizontal cable distance is 90m of installed twisted pair cabling, with 100m of maximum total length including patch cords.
- Each outlet must consist of either flush-mounted or surface-mounted, high-quality category 5e or higher RJ45 modular jacks with IDC-style or 110-style wire T568A or B terminations. Consistency must be maintained throughout the installation. Jacks must meet EIA/TIA-568 recommendations for category 5e or higher connecting hardware.
- Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable should correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations. Faceplates should be modular.

Guidelines – Telecommunication Room Interior Environment

- Carpet should *not* be installed in closets.
- The major components of the building electrical system should not be co-located in the telecommunications room.
- *Closet space should be dedicated to serving telecommunication needs only*.
- Electrical installations supporting telecommunication functions only should be located in the closet.

Guidelines – Telecommunication Room Terminations

- Each TR should contain at least one universal, self-supporting 19-inch data rack with vertical and horizontal cable managers. Each rack should be securely mounted to the floor and braced to the wall using a section of cable tray.
- If fiber optic cable is to be terminated in the closet, attach a fiber optic patch panel to the uppermost part of the data rack.
- All incoming cables should be routed on the cable tray and neatly dressed down to the patch panels. A cable management panel should be installed directly above and below each patch panel.

Guidelines – Student Workstation Wiring

- Each classroom should have at *least two* student workstation outlets.
- Consideration should be given to placing at least one student workstation outlet on each wall in every classroom.
- A duplex power outlet with ground should be in close proximity to the student workstation outlet.

2. **Teacher Workstation Wiring**
   - Run two cables of category 5e or higher, 4-pair, unshielded twisted pair from the outlet to the wiring patch panel located in the telecommunication room. The cables must be a *continuous run* and not spliced. The maximum cable length must not exceed 295 feet/90 meters as specified in the EIATIA-568-C Commercial Building Wiring Standard. The maximum allowable horizontal cable distance is 90m of installed twisted pair cabling, with 100m of maximum total length including patch cords.
   - Each outlet must consist of either flush-mounted or surface-mounted, high-quality category 5e or higher RJ45 modular jacks with IDC-style or 110-style wire T568A or B terminations. Consistency must be maintained throughout the installation. Jacks must meet EIA/TIA-568 recommendations for category 5e or higher connecting hardware.
   - Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable must correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations. Faceplates should be modular.
3. **Administrative Workstation Wiring**
   - Each outlet must be terminated with two individual cables. One outlet allows for voice and the remaining outlet allows for data. The color stripes on each cable must correspond with the color stripes on the edge connector. Faceplates must match the manufacturer for RJ45 outlets at all locations.
4. **Campus Backbone Wiring**
   - Fiber optic cabling shall be the standard for interconnecting buildings in a campus environment. The fiber optic cable shall contain a minimum of ~~six~~ ten fiber strands and be placed in conduit. The cable must meet or exceed FDDI ANSI Standard X3T9.5 requirements for 1 Gbps transmission.

Guidelines – Teacher Workstation Wiring
- Each classroom should have one teacher information outlet.
- A duplex power outlet with ground should be in close proximity to the information outlet

Standards – Telephone Systems

1. A school telephone system shall be as follows:
   - Provide a 4-pair, minimum Category 5e, CM (CMP where required), UTP cable to all telephone, fax, alarm, elevator, and ancillary voice connections. Provide Multi-Pair, minimum Category 3, CM (CMP where required), UTP, trunk- cables between Telecommunications Rooms and the Main Cross-connect (MC), and between the MC and the Telecommunications Service Entrance Facility (aka DEMARC).
   - Provide telephone jacks and telephones in classrooms, offices, media center, teacher prep areas, workrooms, conference rooms, secretarial areas, telecommunication rooms, elevators, etc., as determined by the District's program needs.
   - Provide fully digital, full-duplex, digital display speakerphones with a minimum of eight (8) programmable function keys in each area where access to the telephone system is needed.
   - Provide a minimum of one fully digital, full-duplex, speakerphone attendant console with multiple programmable function keys and one-touch button calling for all extensions within the building. The attendant console should be located in the main administrative reception area.
   - Provide centralized PABX and phone instrument power with a minimum of four (4) busy-hour standby capabilities for all PABX equipment.
2. Provide personalized programming for each system within the District.
3. Provide personalized training for all users within the District.
4. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607-B specifications.

Guidelines – Telephone Systems

- The telephone system should provide TDM or IP-based voice communications both internally and externally throughout the building and the District.
- The PABX should be a fully digital, IP-Enabled PABX or an all-IP- Based PABX. The all-IP-Based system should maintain the same high level of functionality, redundancy, and programmable features as originally specified. Any all-IP system should employ standards-based signaling and instrument powering. All PABX systems should fully support an E911 system.
- The PABX telephone system should provide the capability for a fully digital, non-blocking, voice communications link between all classrooms and offices within the building. A telephone set is not required in each classroom; however, the necessary wiring infrastructure should be installed so as to provide access to the telephone system on an as-needed basis.
- The PABX telephone system should be capable of inter- operating on a District-wide basis using T-1, PRI, or VOIP trunking between buildings. The PABX system should be connected in order to provide a unified system throughout the District. Trunking should be designed on a P=0.01 basis.
- IP-based systems should also be provided with four (4) busy-hour standby capabilities for all powered switches located in each telecommunications room. Connect the central power supplies to building emergency power when available. All IP instruments and power sources should be IEEE 802.3af compliant.

Standards - Data / Computer Network Systems

1. The data network shall consist of the following:
   - A 4-pair, minimum category 5e compliant, CM-rated (CMP where required), UTP horizontal cabling infrastructure, terminated and tested with a level-III cable certification unit, and provided with a manufacturer's 20 year (minimum) lifetime performance-based warranty.
   - A fiber optic-based backbone cabling infrastructure equipped with multi-mode and single-mode fibers between the telecommunication rooms and the main cross-connect. The multi-mode fibers shall be terminated with fusion- spliced, factory-polished, SC or LC pigtails. The single-mode fibers shall be terminated with fusion-spliced, factory- polished, SC LC or MPO pigtails capable of 10 Gbps operation.
   - A minimum of six (6), 4-pair, minimum category 5e compliant, CM (CMP where required) rated, UTP cables from the service entrance facility to the main cross-connect for the extension of special circuits (T-1, PRI, etc.) that are provided by the service provider.
   - A 25 pair (may be more pairs based on facility size) , minimum category 3 compliant, CM (CMP where required) rated, multi-pair telecommunications UTP cable from the service entrance facility to the main cross-connect to be used for the extension of voice, fax, and alarm circuits that are provided by the service-provider. Trunk cables must be sized to accommodate all telephone system requirements. Investigate the possibility of making a single process communication cabling "utility" through the building and/or campus. The result will be a design methodology that allows a standardized cabling system to serve all communications needs throughout the process areas.
   - A minimum of six (6), 4-pair, minimum category 5e compliant, CM (CMP where required) rated, UTP cables from the main cross-connect to each telecommunications room for special data circuits.
   - A minimum of one (1), 25-pair, minimum category 3 compliant, CM (CMP where required), UTP cable from the main cross-connect to each telecommunications room for voice circuits. Trunk cables must be sized to accommodate all telephone system requirements.
   - Review the building design and place data faceplates, equipped with a single minimum category 5e compliant, CM (CMP where required) rated, UTP cable from the associated telecommunications room, below ceilings to support the deployment, by the Owner of 802.11/n wireless ethernet access points and associated wireless network switching devices and phones. Provide proper spacing for adequate coverage of entire facility. Consult with Owner and consider coverage of selected external areas, playgrounds, entrances, parking lots, commons areas,

Guidelines - Data / Computer Network Systems

- The data network should provide a "high speed" ethernet local area network to all buildings within the district, providing a minimum of 100/1000 Mbps switched ethernet connectivity between all computer devices, such as file servers, printers, etc. The backbone should consist of gigabit ethernet links between the telecommunication rooms and the main cross-connect. Inter- building links should consist of a minimum of two (2) parallel gigabit ethernet circuits arranged in a load-sharing, ethernet trunk with properly programmed VLAN and QoS support.
- The system should include all jacks, patch panels, patch cords, connectors, labels, designation strips, and equipment cabinets or racks (with associated fans, grounding/bonding, wire-managers, labels, power strips, etc.)
- The system should include all inter- and intra-building network electronics, including user layer-2 workgroup switches, layer-3 gigabit backbone switches, wireless switches, routers, and file servers.

Guidelines - Data / Computer Network Systems (continued)

- As a minimum, the network may be used to support the following applications on a local and wide area basis:
  - Data networking
  - VoIP telecommunications
  - Wireless access points
  - Video conferencing
  - Video streaming/media retrieval
  - Automation systems
  - Control systems
  - Security systems
- The network system should also include un-interruptible power supplies (UPS) for all primary components. Provide an SNMP management interface in all UPS units. Provide a minimum of 30 minute (4 hours when used for voice support or security system support) standby power for all network electronics. Connect the UPS units to the building emergency generator when available.

etc. (via externally mounted antennas). Wireless design shall be based on centralized, IEEE 802.3af compliant power sources.

2. Provide all required integration services to setup and program the network (IP addresses, VLANs, routing, wireless surveys, etc.).
3. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA J-STD-607-A specifications.

Standards – Central Sound System / Public Address System

1. Provide a building-wide central sound (public address/paging) system providing communications used for "all call" and emergency announcements. This system shall incorporate a master program clock/bell system used to generate tone signals for class change. This system shall be connected to the voice communication (telephone) system installed in all classrooms. The central sound system shall provide two-way communication with the school administrative office.
2. Provide surge-protected, weatherproof exterior horns protected with wire guards/cages, as required, on the outside of the building at playground and bus drop-off/pick-up locations. All volume controlled speakers shall be operated at a predetermined volume upon an all-call event.
3. Provide wall-mounted type horns protected with wire guards/cages, as required, in gymnasiums, auxiliary gymnasiums, and locker rooms. Non-protected, wall-mounted type horns shall be provided in high school student dining areas, technology production labs, vocal rooms, instrumental rooms, mechanical decks, or other spaces with high ambient noise levels.
4. Instructional spaces shall have speakers recessed in ceiling pads in suspended ceilings. Supply wall-mounted volume controls as required.

Standards – Gymnasium Sound Reinforcement System

1. Provide a separate sound system in gymnasiums for use during instruction periods, student assemblies, public assemblies, and sporting events.
2. Locate main equipment cabinet directly accessible from the gymnasium for ease of adjusting sound levels.
3. Provide a minimum of 2 combination XLR microphone/ auxiliary jacks at opposite ends of space.
4. In buildings where announcements or broadcasts are to be made from bleachers, provide a single microphone and an auxiliary jack in a junction box attached to the bleachers. Provide protective cover plates.
5. Provide a wireless microphone system.
6. Loudspeakers pointed at the bleachers shall provide a maximum 3 decibels difference in sound level across the entire bleacher seating area and 25 decibels over the highest ambient noise level.
7. Provide a feedback elimination system.
8. Provide a portable console/cabinet containing a CD, cassette, and MP3 player unit, mic mixer, mic inputs, and

Guidelines - Central Sound System / Public Address

- Clock design should be based on Power over Ethernet (PoE) devices.
- Consider easily accessible, internally-mounted volume controls for all external paging horns.

associated audio cables for attaching to the permanently mounted microphone and auxiliary input faceplates.
9. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Guidelines - High School Student Dining Area Sound Reinforcement

1. Provide a separate sound system in high school student dining areas for use during media productions, stage productions, student assemblies, or public assemblies.
2. The system shall be designed for a high degree of intelligibility and a full range of stereo music capabilities.
3. Locate the main equipment cabinet in the main high school student dining area control room. Provide a sound reinforcement mixing station in the control room and at the back of the high school student dining area.
4. Locate the main sound reinforcement speakers in a space so all seats are provided with a high degree of intelligibility for both stereo music and speech. Intelligibility shall be a maximum of 3 decibels over the entire seating area and 25 decibels over the highest ambient noise level.
5. Provide a minimum of 2 microphone outlets at locations in the seating area. Locate a microphone patch panel housing XLR microphone/auxiliary inputs on the stage to serve various microphone stands on stage. Provide for on-stage, monitor speakers connected to central amplifier.
6. Provide separate wireless sound systems for both performers and for attendees requiring assistive listening. The assistive listening system shall conform to the Americans with Disabilities Act guidelines.
7. Install speakers used for monitoring this sound system in ready (green) rooms so performers know when to go on stage. Such rooms may include dressing rooms, music rooms, and instrumental rooms. Consider video monitor jack for video monitoring.
8. Provide a wireless stage manager communication system dedicated for use by sound, lighting, and stage manager personnel.
9. Provide a feedback elimination system.
10. When equipped with an FM tuner, connect to an FM antenna mounted externally to the building.
11. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Standards - Cafetorium-only Sound Reinforcement System

1. Provide a separate sound system in the student dining area for use during student assemblies or public assemblies.
2. This system shall be comprised of a permanently mounted cabinet or rack (based on space architecture) for housing production and amplification equipment connected to either ceiling- or wall-mounted speakers conforming to the architecture of the space.
3. Provide a minimum of 2 XLR hanging microphone/auxiliary

jacks at opposite ends of space for use.
4. Provide a wireless microphone system located in the rack/cabinet system.
5. Provide a feedback elimination system.
6. When equipped with an FM tuner, connect to an FM antenna mounted externally to the building.
7. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Standards - Music Room Sound Reinforcement System

1. Provide single (shared) portable sound equipment for the playing and recording of music in the high school instrumental, vocal, and ensemble rooms.
2. Provide the instrumental, vocal, and ensemble rooms with wall-mounted speakers and a minimum of 3 XLR wall-mounted microphone jacks distributed throughout the rooms. Provide a minimum of 2 XLR hanging microphone jacks located on the ceilings.
3. The equipment rack shall be mobile housing amplification equipment.
4. Provide a feedback elimination system.
5. The entire system shall be grounded and bonded in accordance with the latest EIA/TIA-607 specifications.

Standards – Optional Security System

NOTE: The inclusion of a security system is an option available to the District. Security systems, when included in project scope, must meet the following standards. Security system recommendations are available in the adjacent Guidelines items.

1. Every system shall be UL approved and monitoring shall be provided at UL approved central station.
2. Alarm system shall have a battery backup (UPS system) for power of at least 4 hours. Provide SNMP management on UPS system and connect to network. Provide for graceful shutdown of equipment.
3. Every alarm system shall communicate over a dedicated telephone data line.
4. System shall be programmed to accept individual alarm access codes from authorized employees. Codes are not to be shared.
5. Every door, hatch or other port of entry will be fitted with an alarm contact. Each entry point will be backed up by motion detectors.
6. Panic buttons will be installed at reception areas.
7. Each keypad will have a distress code.
8. The systems will be supervised, i.e., power failure, line cut, and communication failure will signal the monitoring station of the problem.
9. Minimum Standard: Access Control Systems
   - The primary security system will be the access control system, consisting of a CPU, software, control modules, wiring, readers, and strikes/locks for selected exterior doors.

Guidelines – Optional Security System

NOTE: The inclusion of a security system is an option available to the District.

Within the building security system allowance designated in Chapter 1, provide as many of the following provisions as possible. The following recommendations represent a reasonable expectation of protection within budget constraints and security needs of the District. The design professional should specify the priority security systems to fit the site/building conditions.

- Access Control System
- Intrusion Detection System
- Closed Circuit Television (CCTV) System

Consideration shall be given to centralizing and integrating the system on a District-wide basis via the wide area network, where available.

- All access control systems shall be a commonly available operating system. If the facility is existing, the operating system shall be compatible with the existing system. Provide SNMP management on UPS system and connect to network. Provide for graceful shutdown of equipment. The controller shall be IP-connected to the network and shall permit viewing and control over the network, via PCs. Connect the central power supplies to building emergency power, when available.
- Doors protected by access control will open for exit by using a crash bar release. Each of these doors will be monitored via the door alarm contact for being propped or stuck open. In an emergency, the protected doors can be seized allowing exit only.
- The system will be on a programmed schedule that automatically unlocks the doors for admittance at the start of the day, locks doors (except the main entrance) during class hours, and locks all doors at the close of the day. This will funnel visitors to the front door where they can be observed and controlled.
- Access controls system shall be interfaced with the building fire alarm.

10. Minimum Standard: Intrusion Detection System
    - Every exterior door has a door contact and backup up by motion detection in the corridors to protect the facility from after-hours intrusion and to summon authorities in an emergency situation.
    - Install motion detectors on all floors of the facility in corridors and all rooms with outside access.
    - The alarm system shall be integrated with the building lighting system and shall activate the corridor lights and other selected areas in the event of alarm activation.
11. Minimum Standard: Closed Circuit Television Systems
    - Cameras: All cameras will be color, CCD chip technology. High contrast areas should use wide dynamic cameras. Those abilities will be designated at the design phase and based on need. All cameras will be equipped with an automatic iris to control light. Compatible lenses specific to each placement and required field of view will be used. Cameras with integral motion detectors are acceptable. Limit internal camera spacing to 150 feet maximum. Provide a dedicated camera for each building entrance. Use appropriate lenses for application.
    - Mount external cameras in an appropriate, environmentally controlled enclosure. Mount internal cameras in smoked-dome enclosures.
    - All cameras shall be capable of being viewed and digitally recorded at the same time.
    - Controllers: Should the design call for cameras that can pan, tilt, and zoom, they will require a controller that can move the cameras. The system shall have a battery backup (UPS system) for power of at least 4 hours. Provide SNMP management on UPS system and

Guidelines – Optional Security System

Access Control System

- The system should have the ability to integrate alarms and video signals into one centralized system.
- The number of doors on the system will vary from building to building; however, a minimum number of doors should be selected for access control devices.
- Card readers should be proximity or biometric readers.
- All other exterior doors should be equipped with fire panic devices to prevent entry while allowing exit. Remove exterior hardware.

connect to network. Provide for graceful shutdown of equipment. The controller shall be IP connected to the network and shall permit viewing and control over the network, via PCs. A separate security VLAN shall be established. Connect the central UPS to building emergency generator when available.

- Recorder: Each recorder shall be digital and provide for a minimum of 30 days of storage. Each recording system shall be equipped with provisions for extracting digital images and transferring to a CD or DVD. The recordings shall contain a digitally encoded date and time for each camera. Each recorder shall be equipped with digital image enhancement capabilities. The recorder shall be network connected and shall be capable of being viewed and controlled remotely from a PC workstation over the data network.
- Camera Power: All cameras will be powered by low voltage wire and transformers connected to central UPS power with a minimum of 4 hours standby. The wire will be run with the copper video transmission cable. Twisted pair cabling shall be limited to 90 meters without the use of a repeater. Category 5e, IP, or Baseband video systems are acceptable. In-line or parallel power is acceptable. Exterior installations shall be OSP rated. The wire must be tied to a support cable if run above the ground, and every camera should be grounded with surge suppressors for lightning strikes. The lightning protectors shall be properly grounded in accordance with NEC and EIA/TIA-607 and connected to the associated telecommunications grounding bus (TGB).
- Exterior Housings: Exterior cameras will be placed in climate- controlled and vandal-resistant housings. Exterior cameras will be placed no more than 1,000 feet apart. Exterior camera housings shall be grounded in accordance with NEC and EIA/TIA-607-B. Provide surge protection for all exterior mounted cameras utilizing conductive cabling.
- Monitors: Systems with 4 or fewer cameras will be monitored with a 13-inch (minimum) color monitor. Systems of 5 cameras or more will be monitored with 20-inch color monitors.

12. An exterior horn and strobe light that signals an alarm break will be part of this system.
13. The alarm company will provide monthly reports detailing alarm system use, including opening, closing, and alarm conditions.
14. Provide security screens for windows if warranted by the specific project location and exposure.

Guidelines – Optional Security System

CCTV System

- Provide exterior cameras and adequate cameras in the corridors, plus the head end equipment (digital recorder, monitors, multiplexer, and power).
  - Cameras may be stationary or they may be pan, tilt, or zoom. Pan zoom tilt (PZT) should be considered for external cameras.
  - PoE IP Cameras should be strongly considered due to migration away from analog camera systems.
  - Exterior cameras should be day/night with IR sensors.
  - The camera system should be equipped with motion detectors for changing the frame per second recording rate, depending on system set up.
- Cable runs exceeding 500 feet may require the use of fiber optic cable. Exterior installations can have the cable above or below ground
- Exterior installations can have the cable above or below ground.
- Recorders: NVR's should be used if network bandwidth allows.
- Monitors: An additional 20-inch (minimum) color monitor should be mounted on the ceiling at the public entrance to show that cameras are being used in the public areas.

Guidelines - Optional Interactive Classroom Design

Videoconferencing classrooms require special attention to ensure that the highest quality sound and visual signals are transmitted and received by participants. The following are recommendations on the building of interactive videoconferencing rooms:

- Location: A quiet, convenient and central location is best. It should be isolated or separated from the sources of loud outside noise. This minimizes the need for sound isolation treatment. The room should be near an area that allows for direct and indirect supervision of the class (for monitoring students, security and liability reasons). Access should be suitable for a person with a physical disability. A ground floor location is preferable. Areas to avoid are those that are located near high traffic areas, lifts, plumbing, workshops, and plant rooms. Care should be taken to diminish the sounds from the air conditioning ducts, the gymnasium, band room, shop, or cafeteria.
- Classroom Size: Classroom size depends on the maximum number of participants you hope to have in your room. We suggest planning for a minimum of 20 participants, but ideally be prepared to accommodate at least 25, with tables and chairs. The space should be approximately 24 feet wide by 30 feet long, with a ceiling of 9 feet minimum, to accommodate compressed interactive equipment along with 20 students, or a majority of the faculty for staff development. For teaching seminar groups involving 100 or more, the system should be placed in a lecture theatre setting. Consideration shall be given for appropriate acoustics.
- Classroom Shape: To reduce acoustic effects, square rooms should be avoided, if possible. An oblong or irregular shaped room is a better shape, as it does not encourage standing waves (and thus echoes).
- Physical Layout: Room layout will depend on the number of participants, the available space and the purpose of the room. Layout is a compromise between clear audio, the best viewing of monitors, interaction, and the space available.

Guidelines - Optional Interactive Classroom Design (continued)

- Acoustics: Audio quality is one of the most critical technical elements in a successful videoconference, and it has implications for the selection and placing of the room, as well as for its construction and treatment. The participants and presenters must hear each other clearly, both locally and remotely, without strain. Some factors influence the quality of the sound in a videoconference; namely, ambient noise, room acoustics and reverberation, and equipment configuration.
  - Acoustic treatment of rooms will need to be executed with materials that satisfy the relevant building regulations, so it is essential that this work be supervised by qualified staff.
  - The internal acoustics of a room are very important. Too much reverberation (echoes in a closed room) will present problems. Rooms should not be too absorbent, as this will present an unnatural and uncomfortable environment for the participants. A room that suffers badly from echoes should have the acoustic treatment applied to the adjacent walls rather than the two opposite ones. This will allow standing waves to be reduced in two dimensions (lengthwise and widthwise).
  - Hard blank walls can be deadened by heavy curtains, which have the added bonus of improving the décor. Carpets and other soft furnishings will improve the acoustics and will generally be more cost-effective than acoustic ceiling tile.
- Windows: The ideal room has NO windows. Windows always cause problems for television cameras due to the changing light levels. Window Treatments: If windows are unavoidable, heavy curtains or drapes should be applied to improve acoustics.
- Entrances: Entrance at rear of the room is the best option. Access should be suitable for a person with a physical disability.
- Flooring: There should be carpet on the floor. Carpets and other soft furnishings will improve the acoustics and will generally be more cost- effective than acoustic ceiling tile.

Guidelines - Optional Interactive Classroom Design (continued)

- Lighting: Fluorescent lighting is the most realistic choice for these rooms. Normal office lighting levels will be adequate, i.e., 500 Lux, and an intermediate or warm fluorescent tube color (equivalent color temperature 3200-4000 Kelvin). There should not be a buzzing sound projected from the lights in the classroom.
    - Install lighting at the front of the room but ensure that it is on a separate switch from the rest of the room lights. As a general practice, it is advised that classroom lighting, even in traditional classrooms, be "zoned" into rows of separately switched lights. These rows should run across the width of the room, not down its length. In this way the front of a room, beside the projection screen, can be darkened to give better contrast to the projected images, but still retain a good level of light over the participant's desks.
        - Recommend using high efficiency T-8 lamps and electronic ballast along with the use of occupancy light sensors to prevent energy waste in unoccupied areas and/or buildings, along with copy/work rooms, rest rooms, etc.
- HVAC: The HVAC should be seen – not heard in the classroom.
- Microphones are sensitive to moving air. The microphone amplifies normal air conditioning and can cause a large amount of background noise in a videoconference. Air conditioning/handling equipment will also require installation by experienced staff to ensure the quality of air is adequate and the temperature, humidity, etc. are of an acceptable standard.
- Communication: There should be a dedicated phone line and phone in the videoconference room. It is also recommended that there be a FAX line in the room. It is suggested that you have at least one phone and an additional phone line, or jack, in the room for a FAX line or expansion in the future.
- Computer: Videoconference rooms should have a minimum of four areas to access a computer and the Internet.

Guidelines - Optional Interactive Classroom Design (continued)

- Electrical: Electrical installations need to comply with current National Electrical Code (NEC) wiring regulations and should be carried out by competent and qualified staff. The equipment used for videoconferencing should be powered from a clean main supply to avoid electrical interference. It should not be on a circuit that is shared by large electrical loads such as plant motors, lifts, workshops, etc.
- Wiring: To minimize hum pickup, signal cables (i.e. sound and vision) should not be run parallel to main supply cables; this is especially important for microphone cables. Also, do not run over or parallel to lighting ballasts.
  - Several cables should be run from the control desk to the picture monitors and loudspeaker/audio mixer and also to the CODEC, wherever these are situated. Some provision must be made for small ducting or conduit to protect these cables.
  - When cable runs across floor spaces cannot be avoided, some form of protection must be provided. Special rubber cable protectors are available that protect the cables and minimize the risk of tripping.
- Room Color: Generally high contrast color is desired. Light Blue or light gray is commonly used. Stay away from dark and vivid colors. One recommendation is Periwinkle Blue, or Slate Gray.
- Furniture: Individual sites will have their own preferences for the type of furniture to be installed. Try to avoid bright, reflective surfaces that may cause unwanted highlights in the picture and distract the viewer from the main subject matter.