Introduction

Purpose

The intent of Chapter 7 is to provide standards and guidelines necessary to plan, design, and construct school facilities throughout the state of Connecticut. The focus is on building systems and materials to provide buildings that are economical and reflect quality construction, along with mandatory performance standards, additional options, and available choices. All items and systems, such as loose furnishings, casework, technology, etc., should be integrated early in the planning phase of the project.

Definitions

The planning and design of school facilities shall be based upon criteria described in Chapter 7 in accordance with the following definitions:

"Standards" - Performance or construction required items for which there is mandatory adherence.

"Guidelines" – Performance or construction items which are recommended, but NOT required.

"Components," "Examples" – Typical element(s) of standards or guidelines.

Codes and Standards

It is the responsibility of the Design Professionals to conform to the current codes in their design process. Should the standards contained in the *Standards & Guidelines* be in conflict with international, state, or local codes, the established codes shall prevail. The requirements of ADAAG (Americans with Disabilities Act Accessibility Guidelines) should be consulted. Also, it is required to adhere to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings*.

No attempt has been made to provide detailed specifications in Chapter 7. Standards and guidelines are available that allow architects and engineers the flexibility to design to fit the Local Educational Agency's (LEA) needs.

Applicability

The construction and performance standards and guidelines contained herein are applicable to both new construction of public school facilities and renovation of existing public school facilities. Every attempt should be made to apply these standards and guidelines to existing buildings, in gradual steps as funding and other influences allow (refer to Chapter 1). It may be recognized that some standards may not be compatible with existing facilities in renovation projects nor may it be possible to completely conform a performance or construction standard to a new facility. Upon request, variances to the standards may be granted by the Office of School Construction Grants & Review.

Connecticut's High Performance Requirements

The Regulation

State of Connecticut Regulation Sections 16a-38k-1 through 16a-38k-9 were "adopted primarily to require state-funded buildings to be built utilizing a high performance building standard equivalent to that of the United States Green Buildings Council (USGBC) Leadership in Energy and Environment Design (LEED) Green Building Rating System™-Silver. This rating system primarily focuses on five areas of concern: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Complying with these regulations will produce buildings that consume less energy, conserve natural resources, are more comfortable, healthier, and are easier and less costly to maintain."

"Complying with these regulations will produce buildings that consume less energy, conserve natural resources, are more comfortable, healthier, and are easier and less costly to maintain."

The Manual

Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings has been "developed to assist state and building code officials, architects, and contractors in complying with State of Connecticut Regulation Section 16a-38k-1 through 9: The Establishment of High Performance Building Construction Standards for State-Funded Buildings."

The Manual contains guidelines and requirements for meeting both mandatory and optional strategies to ensure compliance with the regulation.

Design Process

"All building construction projects shall follow an integrated design process to set environmental and building performance goals." (Regulation)

Commissioning

"Building Commissioning shall be an integral part of the building project." (Regulation)

Definition

" 'Commissioning' means the process of verification that the building's systems perform as designed and according to project requirements and construction documents, including assurances that the specified systems are installed properly and adjusted correctly." (Regulation)

Benefits of Commissioning

- Improved performance of building equipment and building systems interactions
- Improved IAQ occupant comfort and productivity
- Decreased potential for building Owner liability related to IAQ
- Reduced operation and maintenance costs
- Maximize energy efficiency
- Provide training for school personnel

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Civil Sitework

Components

- Building Placement
- Ingress, Egress Routing
- Sidewalk
- Trash Enclosure
- Curbing
- Signage and Striping
- Pavement
- Subgrade, Building Pad
- Grading and Drainage
- Water, Sewer, Other Utilities

General Standards

1. This section establishes the minimum design and construction requirements for civil sitework for new construction and expansions of school facilities.
2. All drawings including surveys and civil plans shall be submitted in .pdf format.
3. Site design shall be performed under the supervision of a Licensed Design Professional and all civil related plans, reports and construction documents shall be signed and sealed in accordance with state statutes.
4. All site design shall conform to the applicable codes and to Federal, State, and local requirements of the Authorities Having Jurisdiction (AHJ).
5. A subsurface geotechnical analysis shall be performed by a Licensed Geotechnical Engineer to determine soil properties and provide recommendations for design of footings, foundations, pavements and construction techniques.
6. The following publications (latest edition) shall be consulted by the Design Professional and are hereby included for reference:
   - Americans with Disabilities Act (ADA)
   - American Association of State Highway and Transportation Officials (AASHTO) Design Greenbook
   - Institute of Transportation Engineers (ITE Manual)
   - Manual on Uniform Traffic Control Devices (MUTCD)
   - Connecticut DOT Form 816.

Site Design Standards

1. Site planning and building placement – The placement of the building shall be closely coordinated with the architect to make good use of the property and ancillary facilities. The various modes of travel (pedestrian, bicycle, cars, buses, delivery vehicles) shall be separated as much as possible to provide safe and efficient access. Special attention shall be given to ingress and egress of pedestrians, passenger vehicles, and buses, and short term and long term parking locations for each. Pedestrian and vehicular conflicts shall be minimized, as much as possible. Consideration shall also be given for proper drainage of the site during site planning design.
2. Parking – See Chapter 4 for number of spaces required for each type of school. All accessible parking shall be designed per the latest edition of the Americans with Disabilities Act (ADA) Federal Guidelines and/or the local codes, whichever is more stringent. A parking summary shall be included on the site plan.
3. Sidewalks - Sidewalks shall be designed for access from the parking areas to all entry doors, as well as an accessible path from the street frontage, per ADA guidelines.
4. Trash Enclosure – Trash enclosure shall be provided in a location accessible to trash trucks without conflicting with pedestrian routes or bus pick-up/drop-off point. The size of the enclosure may vary by size and number of dumpsters available from the provider. Where practical, recycling may also be staged in the trash enclosure area.
5. Curbing – Curbing shall be provided around the entire pavement perimeter and at all pavement edges. All curbing shall be defined on the site work drawings as to type of curb, size and general location.
6. Traffic Signage and Striping – Traffic signage shall conform to the Manual on Uniform Traffic Control Devices (MUTCD), and at a minimum shall include stop signs where traffic leaves the school property and/or enters a public thoroughfare. The school shall defer to local authorities for proper off-site signage of public rights-of-way.

Pick-up/Drop-off Area Sidewalks
Consideration for wider sidewalks in pick-up/drop-off areas and areas leading to main entries are recommended.

Bollards at Trash Enclosure
Bollards are recommended at each corner of the enclosure, where exposed to traffic.

Signage and Striping
Additional interior signage, including pedestrian crossings, stop signs, directional arrows, and informational signage may be necessary.

Striping and pavement markings should be considered to aid in the sage and efficient movement of vehicles through the site.

Pavement Design Standards

1. Pavement design shall be based on minimum design period of twenty (20) years as recommended by the geotechnical engineer and shall consider such variables as the California Bearing Ratio (CBR) of the soil, anticipated traffic volume and vehicle mix; i.e., automobiles, buses, single axle trucks, double axle trucks, etc. The Design Professional shall consult the ITE Manual, as well as Chapter 4, for determination of anticipated traffic loads for various school types and sizes. The design shall also be based on sound

geotechnical practices, existing soil conditions, knowledge of local conditions, and availability of material and pavement performance.
2. Pavement and base materials shall conform to the Connecticut Department of Transportation specifications for materials and pavement design.
3. Asphalt pavement design shall conform to CT DOT specifications and consist of three layers: surface course, binder course, and crushed aggregate base course, resting on a properly prepared subgrade.
4. Concrete paving shall have a minimum strength of 3000 psi.

Subgrade and Building Pad Preparation Standards

1. Site-specific recommendations by the geotechnical engineer shall supersede this section.
2. Topsoil shall be stripped from the site and stockpiled (on-site if possible) per the geotechnical recommendations. Topsoil removal shall be to a sufficient depth to remove the layers containing organics. Topsoil may be reused for top dressing of landscape areas or other non-structural fill areas, where applicable.
3. Preparation of the site subgrade shall be per the recommendations of the geotechnical engineer, and may include scarifying and re-compaction, over-excavation, cut, fill, lime stabilization, cement stabilization, dewatering, moisture conditioning, or compaction.

Grading and Drainage Design Standards

1. The site shall be graded to safely and efficiently convey storm water through and around the site.
2. The site shall be designed to safely convey the 100-year storm event. When storm water piping is used, piping shall be designed to convey the 25-year storm event, or per the AHJ, whichever is greater. The site shall conform to the AHJ requirements for storm water detention/retention, if required.
3. The Design Professional shall set the finish floor elevation of the building at an elevation at least 1’ above base flood elevation (BFE), or per the AHJ requirements, whichever is greater.
4. Grading around the building shall slope away from the building at a minimum of 2% slope for at least 10’ from the building walls. Care should be taken to ensure that landscaping, mulch, topsoil, sod or other materials do not inhibit proper drainage around the base of the building. Where possible, foundation plantings and irrigation close to the foundation walls should be avoided, in order to reduce the effects of moisture under the footings and slabs.
5. Surface drainage swales through playscapes and play areas

shall be prohibited. Inlets and/or pipe openings in playscapes and play area shall be avoided, and if unavoidable, shall be adequately designed to prohibit students from access.

6. Ponding around drainage inlets in paved areas shall be limited to a maximum of 6" depth.
7. Storm water detention/retention areas shall be adequately fenced to prohibit accidental student access. Detention areas should be placed away from play areas and playscapes.
8. All drainage inlets on school sites shall be designed as "child safe" to reasonably prohibit student access into inlets and drainage boxes.
9. All grated inlets shall use "bicycle safe" grates.

Water and Sewer Design Standards

1. Domestic water and sanitary sewer shall conform to the requirements of the Connecticut Department of Health.
2. Design of the water system shall include the necessary domestic and fire protection needs for the site. The civil engineer shall coordinate with the plumbing engineer to ensure the system has the adequate capacity for the needs of the site.
3. Water system design shall include all main lines, service lines, and fire lines outside the building, as well as fire hydrants, meter locations, valves, and other appurtenances.
4. Water pipe materials may include copper, PVC, and ductile iron conforming to American Water Works Association specifications.
5. Water lines shall be designed for burial below frost depth and of adequate depth to avoid damage during construction.
6. All facilities with food preparation shall have a PVC/cast iron grease trap located outside of the facility.
7. Utility easements shall be provided where public mains cross private property.
8. Proper trenching and bedding of water and sewer lines shall be required.
9. Trenching and construction shall comply with all OSHA requirements. The site shall be graded to safely and efficiently convey storm water through and around the site.

Utility Design Standards

1. Utility services shall be placed underground, where possible.
2. Electrical transformers and other utility appurtenances shall be placed away from playscapes, play areas, and pedestrian walkways, or fenced to adequately prohibit

student access.

3. All vaults, meter boxes, and pull boxes in traffic areas shall be “traffic rated.”
4. Utility easements should be provided for primary electric service runs to and including the transformer location. Secondary electric service runs typically do not require easements.
5. Empty conduits for future use should be provided under paved entrances and driveways.
6. Proper trenching and bedding of utility lines shall be required.
7. Trenching and construction shall comply with all OSHA requirements.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Foundations and Floor Slabs at Grade

Components

- Spread footings and wall footings
- Trenched footings/turned down footings
- Drilled piers
- Reinforced concrete foundation walls
- Reinforced concrete masonry walls utilizing normal weight masonry units with all cores grouted and reinforced
- Concrete grade beams
- Driven piles and pile caps
- Auger cast piles and pile caps
- Other systems if recommended and acceptable to the geotechnical engineer and the structural engineer
- Where expansive clays are present on the site, the geotechnical investigation is to address such and special foundation and floor slab systems and/or undercutting and backfilling shall be utilized as recommended by the geotechnical engineering investigation.

Standards

1. Foundations shall be designed by a Licensed Design Professional to meet the recommendations given by a geotechnical engineer based upon his or her geotechnical investigation and report and in accordance with the current state building code.
2. Structurally sound
3. Deflections and differential movement to be limited to magnitudes compatible with other building components.
4. Compatible with soil type
5. Water barrier
6. Long life expectancy
7. Sub-slab ventilation in areas with radon or potential soil gas submissions. Requirement for such is to be determined by qualified testing agency.
8. Concrete minimum compressive strength at 28 days to be as required by structural engineer's design.
9. Concrete reinforcing steel shall be a minimum grade 60 and meet the requirements of the current state building code and structural engineer's design.
10. Project site concrete mixing shall not be used, unless otherwise approved by an independent testing agency.

Form Release

Use low and non-toxic form releases.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Framing Systems

Examples

- Steel roof deck on open web steel joists or steel beams: all steel members in exterior walls or roofs to be galvanized.
- Cementitious deck on open web joists
- Composite action concrete slabs and steel beams
- Pre-engineered building systems
- Concrete on steel form deck floor
- Cast-in-place floor slabs (*1-way or 2-way*)
- Steel and/or reinforced concrete columns and beams
- Load bearing masonry walls
- Other systems if recommended and acceptable to the structural engineer and Owner and in accordance with the applicable Fire Prevention and/or Building Codes

Standards

1. Structurally sound
2. Structural systems and members shall be designed by a licensed structural engineer to meet current state fire prevention and building codes and to have adequate stiffness to limit deflections and lateral drift to the requirements of these codes.
3. Steel roof deck: as designed by structural engineer
4. For cementitious decks, use galvanized sub-purlins.
5. For roof slopes greater than 1:12, metal joists shall span parallel to the slope.
6. Do not use calcium chloride in concrete.
7. For structural steel, comply with the American Institute of Steel Construction (AISC) specifications and current state building codes.
8. Steel joist manufacturer shall be certified by the Steel Joist Institute (SJI).
9. Structural steel fabrication must be in accordance with standards.
10. Steel form deck shall comply with the Steel Deck Institute (SDI) design manual (publication no. 27).
11. Structural masonry columns shall be filled and reinforced.
12. Load bearing masonry walls shall comply with current state building codes.
13. Reinforced masonry lintels shall be used in exterior walls wherever possible.
14. Concrete mix design to be designed and strength tested by qualified independent testing agency to meet these requirements and any others from the Design Professional.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Wall and Ceiling Finishes

Examples

- Paints
- Stains and transparent finishes
- Multi-color coatings rubber flooring
- Vinyl-coated fabric wall covering - PVC free
- Suspended acoustic ceiling systems or acoustical panels
- Sprayed-on acoustical treatment
- Acoustical wall treatment
- Abuse resistant acoustical panels
- Metal ceiling panels
- Wood ceilings

Performance Standards

1. Non-toxic and non-polluting materials (low-VOC)
2. Can be cleaned with non-polluting maintenance products
3. Specify only composite wood and agri-fiber products, or products containing these as substrates, that are third-party certified to comply with formaldehyde emissions requirements in the product's ANSI standard, the Composite Panel Association Environmentally Preferable Product Standard, or that contain no added urea formaldehyde resins. Do not use in high humidity or wet areas.
4. Materials and finishes need to adhere to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings.*

Performance Guidelines

- Maximize use of recycled content products.
- Consider initial costs and life cycle costs.
- Consider products that can be repaired or replaced by local persons.
- Consider ease of installation.
- Consider sound absorbing qualities.
- Consider use of locally available materials.
- Consider reflectance values of walls and ceilings.
- Consider wall and ceiling products or systems appropriate for specific functional spaces with and acoustical properties.

Paints and Vinyl Wall Coverings

Examples

- Paints
- Stains and transparent finishes
- Multi-color coatings rubber flooring
- Vinyl-coated fabric wall coverings – PVC free

Construction Standards

1. Use low-VOC emitting paints.
2. Use water-based acrylic latex paints in lieu of solvent-based paints on non-metal surfaces.
3. Use alkyd enamel paints on metal surfaces.
4. Apply water-based paints within a temperature range in accordance with the manufacturer's recommendations.
5. Vinyl-coated fabric wall covering: total weight minimum 22 oz. / sq. yd.; adhesive VOC content of 50 grams/liter or less
6. Provide proper ventilation during application, curing, and occupancy.
7. Use water-based epoxy paints in interior areas with high humidity or subjected to surface moisture.

Performance Benefits

- Easy to clean

Performance Guidelines

- Wall coverings: maximize use of recycled and recyclable materials.
- Consider light value colors to enhance day-lighting.
- Paints: Consider abrasion resistance, hide ability, odor, overall appearance, and application method.

Acoustical Ceilings and Panels

Examples

- Suspended acoustic ceiling systems or acoustical panels
- Sprayed-on acoustical treatment
- Acoustical wall treatment
- Abuse resistant acoustical panels
- Metal ceiling panels
- Wood ceilings

Construction Standards

1. Ceiling suspension system: conform to ASTM C 635; main and cross runners roll-formed from cold-rolled steel sheet, pre-painted; hot-dip galvanized per ASTM A 653, G30 coating
2. Ceiling panels shall meet ASTM C 1264 for Class A materials.
3. Acoustic ceiling panels shall have a minimum Noise Reduction Coefficient (NRC) 0.55 and Ceiling Attenuation Class (CAC) 35 rating.
4. Spray-on acoustical treatment: minimum NRC of 0.65 per ASTM C423, and a maximum flame spread rating of 15, and smoke developed of 0 per ASTM E84 thickness as necessary to accomplish design R-value and STC values
5. Acoustical wall treatment: rigid glass-fiber board and fine-grain cork core faced with fabric
6. Abuse-resistant acoustical panels: flame spread rating less than 25; wood fibers and hydraulic cement binder composition
7. Specify low formaldehyde acoustical ceiling panels.

Performance Benefits

- Good sound absorption qualities
- Low cost ceiling application

Performance Guidelines

- Consider ceiling tiles that contain a minimum recycled content of 20 percent.
- Ceiling panel anti-microbial treatment is optional.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Exterior Walls

Examples

- Masonry veneer cavity walls
- Masonry veneer and metal framing walls
- Masonry veneer and wood framing walls
- Pre-cast concrete insulated panels
- Metal panel on concrete masonry walls
- Metal panel on metal framing walls

Standards

1. Exterior Insulation Finish System shall use impact resistant mesh – must resist breakdown from projectiles.
2. Moisture resistant – provide vapor retarder to inside of insulation.
3. Air barrier to be tight and continuous
4. Detail roof/wall intersection to provide a continuous air barrier system.

Guidelines

- Economical – consider life cycle evaluation
- Light-colored exterior walls
- Preference given to non-combustible materials

Masonry Veneer Cavity Walls

Components

- Exterior finish
  - Exterior stone, clay, or concrete masonry units
- One-inch air cavity
- Cavity insulation
  - Rigid insulation or closed cell polyurethane insulation
- Air barrier system
- Back-up material
  - Concrete masonry units (normal weight)

Standards

1. Impact, moisture, and thermal resistant
2. Fire resistant
3. In-wall flashing – copper fabric laminate; elastomeric thermoplastic; sheet metal
4. Drain cavity with weep holes – use mortar dropping control product to prevent blocking of weep holes.
5. Steel reinforcement to meet the requirements of the current state building code, including the seismic provisions where applicable.
6. For exterior CMU veneer: provide water repellent.

Masonry Veneer on Metal Framing Walls

Components

- Exterior finish
  - Exterior stone, clay, or concrete masonry units
- Air cavity
- Cavity air infiltration barrier
- Batt/blanket insulation with faced membrane
- Back-up material
  - Cold formed steel framing system
- Abuse/moisture/mold-resistant gypsum wallboard

Standards

1. Impact, moisture, and thermal resistant
2. In-wall flashing
3. Drain cavity with weep holes
4. Mill galvanized wall ties
5. Face brick veneer
6. Concrete masonry veneer: provide color and water repellent.
7. Steel studs to have G90 galvanizing
8. Steel framing system
   - Light gauge steel studs as designed by Licensed Design Professional
   - Pre-engineered steel framing system as designed by Licensed Design Professional

Pre-Cast Concrete – Insulated Sandwich

Components

- Exterior architectural concrete with smooth or exposed aggregate texture finish or thin brick facing
- Rigid cavity insulation
- Structural concrete backup
- Interior finish, if exposed to be smooth concrete or exposed aggregate concrete or a surface applied smooth or textured finish

Standards

1. Impact, moisture, and thermal resistant
2. Low maintenance
3. Meet ASHRAE 90.1-2007 (or later) and current state energy code requirements.
4. Use fiber composite or plastic connectors – no metal connectors.
5. Concrete materials: Portland cement ASTM C-180, Type I or III.

Metal Panel on Metal Framing

Components

- Exterior finish
  - Exterior metal wall panel system
- Weather barrier
- Air barrier system (required)
- Batt insulation with vapor barrier
- Backup materials
  - Cold formed metal framing
- Abuse/moisture/mold-resistant gypsum wallboard

Standards

1. Metal wall panel: minimum 20 year finish warranty
2. Low maintenance
3. Moisture and thermal resistant
4. Weather barrier: composite, self-adhesive, rubberized-asphalt compound flashing product
5. Steel framing system:
   - Steel studs as designed by Licensed Design Professional
   - Pre-engineered steel framing system as designed by Licensed Design Professional

Guideline

- Maximize recycled content

Masonry Veneer on Wood Framing Walls

Components

- Exterior finish
  - Exterior stone, clay, or concrete masonry units
- Air cavity
- Cavity insulation
- Batt/blanket insulation with vapor barrier
- Backup materials
- Abuse/moisture/mold-resistant gypsum wallboard

Standards

1. Impact, moisture, and thermal resistant
2. In-wall flashing
3. Drain cavity with weep holes
4. Mill galvanized wall ties
5. Concrete masonry veneer: provide color and water repellant.

Roofing Systems

Examples

- Shingle roof system
- Metal roof with blanket insulation
- Metal roof with rigid insulation
- Built-up asphalt roof system
- Single-ply roof system
- Modified bitumen roofing system
- NOTE:
  - All roof systems and products shall be designed in accordance with state fire prevention code and state building codes.
  - For roof replacements, please refer to the *State of Connecticut Roof Replacement Program Guidelines.*
  - For High Performance Compliance, refer to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings*.

Other Roofing Systems

- Other types of roof systems may be acceptable if system meets or exceeds the "Performance Standards - Roofing Systems."

Performance Standards

1. Roofing and flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. Fire resistive – meet UL Class "A"
3. Positive slope/drainage to interior drains or exterior collection systems
4. "ENERGY STAR" compliant ratings for surface treatments
5. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of membrane, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
6. Minimum 2-year contractor guarantee on all materials and workmanship of all system components and accessories
7. Low slope roofs drainage is to be designed with all rooftop equipment located.
8. Low slope roofs shall be coordinated with anticipated photovoltaic panels.
9. Sheet metal flashings shall conform to SMACNA's "Architectural Sheet Metal Manual."

Roofing System Guidelines

- Consider installing "radiant barriers," such as aluminum foil above attic spaces.

Construction Standards

1. Provide pre-roofing conference prior to field installation of roofing system to comply with the manufacturer's requirements. Provide post-installation inspection to comply with manufacturer's requirements.

Shingle Roof Systems

Components

- Asphalt shingles, UL Class "A," ASTM B108 or UL790
- Roofing accessories:
  - Felt underlayment
  - Self-adhering sheet underlayment
  - Sheet metal drip edge and flashing
- Oriented strand board (OSB) or plywood
- Rigid insulation
- Vapor barrier, on underside of rigid insulation
- Structural support: steel deck or cementitious deck; or wood deck (lumber, plywood or oriented strand board, OSB) permitted in accordance with Connecticut State Fire Prevention Code and Building Code

Performance Standards

1. Roofing and flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. "ENERGY STAR" compliant surface treatments
5. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of shingles, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
6. Contractor to furnish 2-year guarantee on materials and workmanship for all system components and accessories

Construction Standards

1. Minimum 3:12 slope
2. Fasten shingles to roof sheathing with nails – not staple fasteners. Staples shall not be used on decking.
3. Metal drip edge: brake formed sheet metal with at least a 2 inch roof deck flange
4. Laminated-Strip Asphalt Shingles: ASTM D3462 laminated, multi-ply overlay construction glass-fiber reinforced, mineral-granule surfaced, self-sealing shingles
5. Felt underlayment 30 pound asphalt-saturated organic felts, non-perforated. Use "Ice & Water Shield" or equivalent for slopes less than 4:1.

6. Sheet metal flashings conform to SMACNA's "Architectural Sheet Metal Manual." Includes perimeter edge metal; penetration flashings; valley construction; and apron, step, cricket, or back flashings.
7. Provide pre-roofing conference prior to field installation of roofing system to comply with the manufacturer's requirements. Provide post-installation inspection to comply with manufacturer's requirements.

Metal Roof with Blanket Insulation

Components

- Standing seam metal roof panels, minimum 26 gauge
  - Profile: vertical, rib, seamed joint
  - Material: aluminum zinc alloy coated steel sheet
  - Exterior finish: fluoropolymer two-coat finish system, 70% PDFY resin
- Insulation: glass fiber blanket (Minimum R-value R-19) with vapor tight edge tabs and faced on under side
- Factory primed or galvanized steel purlins
- Solid substrate
- Structural support:
  - Steel joist or truss joists
  - Pre-engineered structural framing system
- Sheet metal drip edge and flashing
- Snow guards

Performance Standards

1. Roofing and flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. System shall have ASTM E1592-94 wind uplift classification.
5. No water penetration when tested according to ASTM E1646
6. Air leakage through assembly of not more than 0.06 CFM/sq. ft. of roof area when tested to ASTM E1680
7. "ENERGY STAR" compliant surface treatments
8. Special warranty on panel finishes by manufacturer: 20 years. Special weather tightness warranty for standing seam metal roof panels, including underlayment, insulation, and flashing, etc. Warranty to be non-pro-rated with no dollar limit.
9. Contractor to furnish 2-year guarantee on materials and workmanship for all system components and accessories (in accordance with terms and conditions of required manufacturer's warranties).

Construction Standards

1. Minimum 3:12 slope
2. Provide break where panels attach directly to purlins.
3. Standing seam assembly: factory formed, cap seam assembly designed for concealed mechanical attachment of panels to roof purlins or deck
4. Provide pre-roofing conference prior to field installation of roofing system to comply with the manufacturer's requirements. Provide post-installation inspection to comply with manufacturer's requirements.

Metal Roof with Rigid Insulation

Components

- Standing seam metal roof panels, minimum 26 gauge
  - Profile: vertical, rib, seamed joint
  - Material: aluminum zinc alloy coated steel sheet
  - Exterior finish: fluoropolymer two-coat finish system, 70% PDFY resin
- Underlayment (ice and water shield)
- Nail base rigid roof insulation
- Structural support: steel deck or cementitious deck
- Sheet metal drip edge and flashing
- Snow guards

Performance Standards

1. Roofing and flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. System shall have ASTM E1592-94 wind uplift classification.
5. No water penetration when tested according to ASTM E1646
6. Air leakage through assembly of not more than 0.06 CFM/sq. ft. of roof area when tested to ASTM E1680
7. "ENERGY STAR" compliant surface treatments
8. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of membrane, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
9. Special warranty by manufacturer on panel finishes: 20 years.
10. Special weather tightness warranty by manufacturer for standing seam metal roof panels: 20 years
11. Contractor to furnish 2-year guarantee on materials and workmanship for all system components and accessories (in accordance with terms and conditions of manufacturer's warranties).

Construction Standards

1. Minimum 1:12 slope
2. Underlayment: self-adhering high temperature sheet, 30 to 40 miles thick
3. Standing seam assembly: factory formed, cap seam assembly designed for concealed mechanical attachment of panels to roof purlins or deck
4. Provide pre-roofing conference prior to field installation of roofing system to comply with the manufacturer's requirements. Provide post-installation inspection per manufacturer's requirements.

Built-Up Asphalt Roof System

Components

- Alternating layers of bituminous sheets and viscous bituminous coatings over an insulated deck

Performance Standards

1. Roofing membrane and base flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. "ENERGY STAR" compliant surface treatment
5. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of membrane, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
6. Contractor to provide 2-year guarantee on materials and workmanship for all system components and accessories (in accordance with terms and conditions of manufacturer's warranties).

Construction Standards

1. System description
   - BU-I-A-G (4) A (Built up membrane over insulated deck using asphalt with glass fiber ply sheets and aggregate surfacing
   - BU-I-L-G2 (coated base) (4) A (built up membrane over insulated deck using cold liquid applied asphalt with ply sheets and aggregate surfacing)
2. Base sheet (recommended by manufacturer)
3. Ply felt: asphalt impregnated, glass fiber felt, complying with ASTM D2178, Type VI or 28 lb. coated base sheets as required by manufacturer to meet warranty requirements
4. Flashing sheet
   - SB5 modified asphalt sheet, mineral granule surfaced, ASTM G162 (composite sheet) or ASTM G164 (polyster)
   - APP modified asphalt sheet, mineral granule surfaced, ASTM G223 (composite)

5. Asphalt materials
   - Roofing asphalt: recommended by built-up roofing manufacturer
   - Cold applied adhesive
6. Auxiliary membrane materials may include: aggregate surfacing, substrate board, vapor retarder, roof coating, and/or protective walkways.
7. Polyisocyanurate board insulation with a minimum compressive strength of 20 psi and faced on both top and bottom
8. Provide pre-roofing conference prior to field installation of roofing system to comply with the manufacturer's requirements. Provide post installation inspection per manufacturer's requirements.
9. Minimum slope ¼:12. Reroofs may remain 1/8: 12 if current roof has 1/8:12 slope. Flat roofs are unacceptable.

Single Ply Roof System

Components

- Uniform elastomeric EPDM membrane, PVC or TPO
- Minimum ½ inch, rigid cover board
- Rigid insulation
- Vapor barrier
- Minimum ¼ inch substrate board
- Structural support: steel deck or cementitious deck or wood deck (lumber, plywood or oriented strand board, OSB)

Component – Rigid Insulation

- Required nail base rigid roof insulation may be installed using one or two layers.
- Recommend that insulation be installed in two layers with joints offset in each direction, to reduce thermal bridging and make the roofing system more energy efficient.

Performance Standards

1. Roofing membrane and base flashings shall
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. "ENERGY STAR" compliant surface treatment
5. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of membrane, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
6. Contractor to provide 2-year guarantee on materials and workmanship for all system components and accessories (in accordance with terms and conditions of manufacturer's warranties).

Construction Standards

1. Minimum slope 1/4:12 for new construction. Reroofs may remain 1/8:12 if current roof has 1/8:12 slope. Flat roofs are unacceptable.
2. Loose laid/ballasted, fully adhered or mechanically fastened ethylene propylene diene monomers (EPDM), TPO, PVC membrane, 50 miles thick minimum
3. Cover board: ASTM C 1177, glass mat, water resistant gypsum substrate Type X, or ASTM C 272 gypsum wood fiber composite board
4. Insulation: extruded polystyrene board or polyisocyanurate board
5. Vapor barrier: polyethylene retarder, ASTM D 4397, 6 mils (0.15 mm) thick minimum
6. Substrate board: glass mat, water-resistant gypsum board

7. Provide pre-roofing conference prior to field installation of roofing to comply with the manufacturer's requirements. Provide post-installation inspection per manufacturer's requirements.

Modified Bituminous Membrane

Components

- Roofing system formed with modified bituminous membranes over an insulated deck

Performance Standards

1. Roofing membrane and base flashings shall:
   - remain watertight
   - not permit the passage of water
   - resist uplift pressure calculated according to current version(s) of applicable code(s)
   - resist thermally induced movement
   - not fail when exposed to weather
2. System shall meet Class 4 per UL 2218 impact test.
3. System shall meet UL Class "A" for fire resistance.
4. "ENERGY STAR" compliant surface treatments
5. Minimum 20-year manufacturer's warranty on complete roofing assembly, inclusive of membrane, underlayment, insulation, flashing, etc. Warranty to be non-pro-rated with no dollar limit.
6. Contractor to provide 2-year guarantee on materials and workmanship for all system components and accessories (in accordance with terms and conditions of manufacturer's warranties).

Construction Standards

1. System description – provide one of the following:
   - MBA(1)-i-(T,M, or L)-G(2)-M or A (modified bitumen APP roofing membrane over insulated deck, mopped or set in cold, liquid-applied adhesive, with glass fiber ply sheet and mineral or aggregate surfacing)
   - MBS(1)-I-(TM, or L)-G(2)-M or A (modified bitumen SBS roofing membrane, over insulated deck, mopped or set in cold, liquid-applied adhesive, with glass fiber ply sheet and mineral or aggregate surfacing)
2. Cap sheet – provide one of the following:
   - SBS modified bituminous cap sheet: SBS modified asphalt sheet, smooth surfaced, dusted with fine parting agent on both sides or granular surfaced; suitable for application method specified; manufacturer's standard thickness and weight; for use of reinforcing type as follows:
     - Use: roof membrane and base flashing
     - Reinforcing: composite woven (ASTM G162) and glass fiber mat
   - APP-modified cap sheet, smooth surfaced: a tactic polypropylene modified asphalt sheet, smooth-

surfaced; suitable for application method specified; manufacturer's standard thickness and weight; for use and of reinforcing types as follows:
- Use: roof membrane and base flashing
- Reinforcing: composite woven (ASTM-G162) and glass fiber mat

3. Auxiliary membrane materials may include: protective surfacing (aggregate surfacing or roof granules); roofing asphalt (as recommended by system manufacturer); substrate board (if required by design professional or roof manufacturer); cold applied adhesive; vapor retarder (if required by project conditions by design professional or manufacturer; and protective walkway materials recommended by system manufacturer.
4. Base sheet: unperforated, asphalt impregnated and coated glass fiber sheet, dusted with fine mineral surfacing on both sides
5. Base ply felts: asphalt coated, glass fiber felt, complying with ASTM D2178, Type VI or 28 lb. coated base sheets as required by manufacturer to meet warranty requirements
6. Polyisocyanurate board insulation with a minimum compressive strength of 20 PSI and faced both top and bottom. Provide tapered insulation, preformed saddles, crickets, tapered edge strips, and other insulation shapes as required for "positive drainage."
7. Insulation accessories as may be recommended by the insulation manufacturer and as compatible with membrane roofing including: fasteners; cold fluid applied adhesive; wood nailer strips; and cover board (perlite insulation board or cellulosic-fiber insulation board)
8. Provide pre-roofing conference prior to field installation of roofing to comply with the manufacturer's requirements. Provide post-installation inspection per manufacturer's requirements.
9. Minimum slope ¼:12. Reroofs may remain 1/8:12 if current roof slope is 1/8:12. Flat roofs are unacceptable.

Openings

Examples

- View windows
- Clerestory windows
- Roof monitors, unit and tubular skylights
- Entrance assemblies
- Interior doors
- Exterior doors

Standards – Doors and Windows

1. Air infiltration rate of less than 0.4 CFM/ft performance class AW and grade 65 by the American Architectural Manufacturing Association (AAMA)
2. Testing for thermal performance according to AAMA 1503
3. Not less than 26 STC when tested for sound transmission loss according to ASTM A90
4. Operating window sash to be factory glazed
5. Windows to be double glazed and have low emissive coating
6. Glass for exterior doors and sidelights shall comply with state fire prevention codes. Provide vestibule at main entrance.
7. Interior doors to be solid-core wood and factory finished except in PE, Shop, gyms, labs and locker rooms. Unfinished doors may be used for renovations and additions. 1 ¾" 16 ga. insulated hollow metal doors with 18 ga. frames may be used in lieu of wood.
8. For a high degree of sound isolation on both interior and exterior doors, provide full perimeter gaskets and automatic door bottoms with a neoprene element for acoustical doors and an STC rating appropriate for the intended use.
9. On exterior doors, provide full perimeter weather-stripping and thresholds.
10. Exterior hollow metal doors shall be insulated.

Performance Guidelines - Openings

- Provide uniform light distribution.
- Provide low glare.
- Reduce energy costs.
- Mitigate safety/security concerns.
- Low maintenance
- Provide day lighting that uses diffused or reflected sunlight.
- Provide window views to help eye health and help reduce stress.
- Encourage "top lighting" to provide best uniform illumination.
- Consider natural daylight for all academic spaces.
- Minimize east and west facing glass.
- Refer to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings*.

Guidelines – Doors and Windows

- Consider selection of interior doors constructed with recycled or recovered content and low VOC (volatile organic compounds) if available.
- Consider selection of interior doors with wood veneers harvested from sustainable forests if available.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Interior Partitions

Examples

- Concrete masonry walls (CMU)
- Glazed tile and ceramic tile
- Metal or wood studs with gypsum wallboard
- Veneer plaster over gypsum wallboard
- Operable partitions
- Folding partitions
- Demountable partitions

Performance Standards

1. Easy to clean materials
2. Resistant to moisture and inhibits the growth of biological contaminants
3. Impact resistant materials in high traffic areas
4. Durable, long life materials
5. Dimensional planning to reduce waste (i.e., 4 ft. by 8 ft. wallboard)
6. Use materials that meet industry consensus standards for VOC emissions.

Concrete Masonry Walls
Structural Glazed Tile Walls
Ceramic Tile

Construction Standards

1. CMU walls: ASTM C90, 1900 psi compressive strength, normal weight aggregate or FM 1500 psi.
2. Tooled or struck mortar joints for cleanability. Use Type "S" mortar for loadbearing walls and Type "N" for non-loadbearing walls.
3. Glazed structural clay tile: ASTM C 126, Type I (single-faced units) and Type II (double-faced units)
4. Ceramic tile: for materials ANSI A 137.1 "Specifications for Ceramic Tile"; for installation ANSI 108 series and TCA handbook
5. Glazed wall tile: 5/16 inch thick, flat tile with cushion edges
6. Grout tile using latex Portland cement grout. Exception: use chemical resistant epoxy grout in kitchens.
7. Control joints required for CMU partition walls per design.

Performance Benefits

- Impact resistant
- Easily cleanable & maintainable
- Good acoustic qualities
- Daylight enhancement qualities

Metal or Wood Studs with Gypsum Wallboard
Veneer Plaster over Gypsum Wallboard

Construction Standards

1. Sound transmission class: Minimum STC of 41 in academic areas
2. Steel framing: comply with ASTM C754 and G40 hot-dip galvanized zinc coating
3. Gypsum wallboard: ASTM C36, Type X 5/8 inch thick
4. Type X wallboard required at rated partitions
5. Moisture resistant wallboard to be used in high moisture areas
6. Metal studs: ASTM C645, 16 gauge sheet base metal
7. Provide control joints in partitions 30 feet maximum.
8. Veneer plaster: ASTM C58T consisting of separate base coat and finish coat
9. Wood stud grade marked as required by the applicable building code
10. Abrasive and impact resistant materials in high traffic areas

Performance Benefits

- Economical
- Relatively easy to move or remove
- Accommodates periodic finish color changes
- Good sound barrier when used with acoustical insulation

Operable Partitions, Folding Partitions, Demountable Partitions

Performance Standards

1. Easily moved from opened to closed (stored) position by manual or electrical operating mechanism
2. Sound transmission class (STC) as provided below in Construction Standards, or as required to meet the sound isolation requirements for the functional use of the rooms or spaces to be divided, whichever is greater
3. Options for tack and marker board surfaces
4. Overhead structural support with minimal deflection as required for functional operation
5. Demountable partitions convenient to disassemble and relocate

Construction Standards

1. Operable partitions: panels ½ inch gypsum board laminated with 3/16 inch natural cork (STC 47) or steel face sheet (STC 50); Panel finish-vinyl fabric, carpet, tack boards or marker boards; pedestrian pass doors as required
2. Accordion folding partitions: steel or aluminum suspension tracks; manually operated; interior 22 gauge steel panels for sound isolation; vinyl coated fabric finish
3. Demountable partitions; face panels of gypsum board painted or covered with vinyl; face panels of steel painted or covered with vinyl or plastic laminate; doors and windows available as required
4. Non-combustible products that meet rated fire or smoke separation building code requirements

Interior Floor Finishes

Examples

- Soft Surface Flooring
  - Vinyl composition tile (VCT and vinyl enhanced tile (VET)
  - Carpet and carpet tiles
  - Rubber flooring
- Hard Surface Flooring
  - Porcelain ceramic tile (CT) with recycled content
  - Quarry tile (QT)
  - Terrazzo tile with recycled content
  - Concrete finish
  - Wood (athletic)

Performance Standards

1. Water-based coatings and adhesives
2. Nontoxic and non-polluting materials (low VOC)
3. Resistant to moisture or inhibits the growth of biological contaminants
4. Can be cleaned with non-polluting maintenance products
5. Suitable for heavy use areas
6. Prior to finish flooring installation, provide moisture testing of concrete floors to meet finish flooring manufacturer's requirements.
7. Materials and finishes need to adhere to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings.*

Guidelines

- Maximize recycled/recyclable content
- Minimize PVC content

Soft Surface Flooring

Examples

- Vinyl composition tile (VCT) and Vinyl enhanced tile (VET)
- Linoleum and sheet vinyl
- Carpet (CAR) and carpet tiles
- Rubber flooring

Construction Standards

1. Carpet: minimum recycled content guideline of 25%, minimum 17 ounce face weight
2. Low-VOC emitting materials. Resilient VOC content limited to 340 grams/liter or less
3. Maximum acceptable moisture emission rate for concrete sub floors:
   - Carpet and sheet vinyl – 3 lbs/1,000 sq. ft. per 24 hours or less
   - VCT – 5 lbs./1,000 sq.ft.
4. Use water-based low VOC adhesives, sealants, and cleaning products.
5. Sheet vinyl with backing: 0.080 inch thick
6. Linoleum: 0.10 inch (2.5mm) minimum thickness

Performance Benefits

- Easy to clean and maintain
- Acoustical benefits
- Physical comfort (cushion)
- Safety for small children

Performance Guidelines

- Maximize recycled or recyclable content.
- Consider meeting Carpet and Rug Institute Green Label Plus criteria.
- Research and use carpet reclamation programs where available for disposal of existing carpet.
- Minimize PVC content where possible.
- Consider life cycle costs including materials, cleaning, and maintenance.

Hard Surface Flooring

Examples

- Porcelain ceramic tile (CT) with recycled content
- Quarry tile (QT)
- Terrazzo tile with recycled content
- Concrete finish
- Wood (athletic)
- Resinous epoxy

Performance Benefits

- Easy to clean and stain-resistant
- Highly durable
- Reasonably economical based on life-cycle cost analysis

Construction Standards

1. Low-VOC emitting materials: flooring, adhesives, grouts, caulk, or sealants
2. Comply with ANSI ceramic tile standard.
3. Mortars and grouts should be based upon the installation conditions and as recommended by the Tile Council of America.
4. Use epoxy-modified grout mixture for high moisture areas.
5. For concrete floors use two-component, water-based, low odor, dust proofing, color pigmented epoxy sealer, or stain.
6. Wood gym floors:
   - maximum 4.5 pounds per 1,000 sq.ft. moisture emission in slab
   - two-year guarantee
   - second and better grade, maple strip flooring

Performance Guidelines

- Consider finishes and/or materials suitable for use in high traffic areas.
- Wood flooring: Use certified hardwood, salvaged wood and/or laminated or veneered wood products where possible.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Specialties

Examples

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

Performance Guidelines

- 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

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 Connecticut Fire Prevention Code and accessibility guidelines, 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

1. Standard lockers: comply with accessibility guidelines; form body from steel sheet; assemble locker units by bolting together; steel frames and doors; recessed handle and latch; baked enamel finish.
2. Provide 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 percent.
7. Toilet compartments shall be floor-mounted, overhead-braced, or ceiling-mounted.

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Equipment and Furnishings

Examples

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

Performance Guidelines

- The PreK-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 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

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-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

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 one-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-year warranty for bleachers.

Performance Guidelines

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

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Plumbing

Components

- 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

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 Connecticut 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 Connecticut Energy Code.
3. 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.
4. Food service grease interceptors, science room acid, neutralizing sumps, and gas piping and regulators shall be designed by the Plumbing Design Professional.
5. For High Performance Compliance, refer to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings.*

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 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.
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 shall be installed in accordance with the Connecticut gas code. The estimated gas loads for operation of 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.
4. The Plumbing Design Professional should coordinate with the HVAC Design Professional and local utility to determine best practice for cooling system(s) condensate discharge.

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.

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 Connecticut 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 the current Connecticut 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 recirculating 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 Connecticut 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 Connecticut 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. Waterless urinals are optional.
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 ADA 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.

Waterless Urinals

- Waterless urinals are optional.

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 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

- 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

1. The heating, ventilating, and air conditioning system design standards criteria denoted as a part of the *Standards and Guidelines* have been developed or are obtained directly from accepted engineering design references such as the ASHRAE handbooks and standards, the state of Connecticut code references, and good engineering practice. School HVAC system plans and specifications shall be prepared by a licensed professional engineer with a valid Connecticut 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 Connecticut Energy Code.
3. All HVAC products shall be rated in accordance with applicable rating programs (where rating has been established) or products manufactured in compliance with policies of the state of Connecticut and in compliance with Connecticut 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 State upon request.
5. All rooftop equipment shall be coordinated with roof drainage.
6. All rooftop equipment shall be securely fastened to resist design wind loads.

Guidelines – HVAC System Selection Life Cycle Cost Analysis

- Several HVAC systems are applicable to Connecticut 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 Analyses should be submitted with the project final review documents. This analysis may be considered as an extra service to the design contract.

7. HVAC systems and materials shall adhere to the *Connecticut Building Standard Guidelines Compliance Manual for High Performance Buildings.*

Standards – HVAC Outdoor Air Ventilation

1. Outdoor ventilation rates shall be calculated for each occupied space and shall conform to the requirements of the Connecticut Mechanical Code minimum ventilation rates. The only exception will be an engineered ventilation system design with written approval of exception by the State of Connecticut.
2. Each system shall include controls for a 100 percent economizer cycle to cool the building when dictated by the Connecticut 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 Connecticut 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 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 Outdoor Air Design Values

- Indoor air temperature design values should reflect the need for energy conservation and should be in accordance with the Connecticut Mechanical Code and the Connecticut 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.
- 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 LEA 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. The HVAC Design 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 Connecticut 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.

Standard – HVAC Equipment Accessibility

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

Standard – HVAC Closeout Documentation

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

Guidelines – HVAC Interior and Exterior Noise Control

- Interior HVAC acoustic design should not cause indoor sound levels to exceed NC30.
- The location of exterior mechanical equipment shall be reviewed by the Design Professional for its sound impact, both inside and outside the building.
- Exterior equipment operation shall not cause indoor sound levels to exceed specified levels for the space.
- 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 Closeout Documentation

- O & M Manuals should be provided in duplicate for the LEA.
- Manuals should contain approved shop drawings, operations and maintenance instructions and parts manuals for all HVAC equipment.
- The contractor shall should maintain and provide to the LEA an accurate set of design plans showing all construction revisions to the design set.

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

- 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 version of the Connecticut 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 Connecticut.
3. Consideration should be given to provide a metering device to measure all electrical usage for new buildings over 20,000 SF.

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. An LEA shall put in place and submit to the Office of School Construction Grants 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 7700. 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 utilizing low harmonic electronic ballasts and low-mercury certified lamps.
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 7700. 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
5. 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).
6. 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 7700.
7. 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.
8. High school student dining area shall be equipped with theatrical type lighting controlled by dimmer banks and control consoles.
9. 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 percent.
10. 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 chalkboards.
11. Provide site lighting to foot-candle levels recommended by the IES.

12. Light fixtures located in gymnasiums and auxiliary gymnasiums shall be equipped with protective wire guards.
13. Exit signs shall be wall mounted, where possible, in lieu of ceiling-mounted and be of the LED type.
14. Art rooms shall be provided with supplemental incandescent track lighting in middle schools and high schools.
15. 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.
16. Options shall be investigated for control of exterior and interior corridor lighting by direct digital control, the energy management system, or occupancy sensors.
17. 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 Connecticut Energy Code. Exterior lighting shall be controlled by photo sensor or astronomical time clock to comply with ASHRAE 90.1 as required by the Connecticut Energy Code to automatically turn lighting off when sufficient daylight is available.
18. 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.
19. 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 7700.
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 7700.
2. Companies designing, installing or servicing fire alarm systems in Group E occupancies shall be properly licensed by the Connecticut Board of Private Investigators, Private Security Agencies and Alarm Systems Companies.
3. Fire alarm shop drawings shall be prepared in accordance with the Connecticut Fire Prevention Code and approved by the State Fire Marshal's office or its 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 LEA with each system.

Standards – Security Systems

1. Provide conduit rough-in and wiring only for key pad locations, motion sensors, door contacts switches, card readers, and control panel.

2. System selection, installation, and funding shall be by the LEA.
3. 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.

Standard – 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 Server (MS).
   - 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, 3½" 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 7700, provide power outlets, technology cabling home-run conduits and projector mounting brackets as follows:
   - Provide one (1), 2-gang, 3 ½" 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 ¼" 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 ¼" 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 ½" 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 ¼" 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 ¾" inch high center divided surface applied metal raceway in computer labs where equipment is located on perimeter of room.
7. Provide one (1) 1 ¼" conduit for every six computer workstation locations stubbed up above the nearest finished ceiling and home run to the Telecommunications cable tray.
8. 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.
9. 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.

10. Provide a minimum of one 4" conduit for Wide Area Network (WAN) from the Service Provider (SP) Entrance (DEMARC) to the property line.
11. Provide one (1), 4" conduit for cable television (CATV) from the Service Provider (SP) Entrance (DEMARC) to the property line.
12. Provide one (1), 4" conduit for the telephone from the Services Provider (SP) Entrance (DEMARC) to the property line.
13. Provide a minimum of two (2), 4" conduits from the Service Provider Entrance (DEMARC) to the Main Server (MS) 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.
14. Provide two (2), 2" sleeves in all classroom walls.
15. All empty conduits shall be provided with a rot, mildew, and tangle resistant pull string.
16. 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.
17. 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.
18. 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 Server, and 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 # 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 Chapter 4, Section 4000			

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"

THIS PAGE HAS BEEN INTENTIONALLY LEFT BLANK.

Technology

Components

- 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

1. A Technology System Plan and Specifications shall be designed and approved by a Registered Communications Distribution Designer (RCDD).
2. All work shall be performed in accordance with the latest revisions of the following standards and codes:
   - State 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

- 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 into 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 Server Rooms (MSs) by centralizing the MSs and/or using one MS to serve multiple floors or areas. For example, in a 3-story building, place the MS 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 MSs 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.

Guideline - Technology – Optional System

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

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.

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 – 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 (ITSP) 2B2.
- The main server (MS), 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 MS is insufficient to cover a building, additional TRs must be established. The same parameters apply for both TRs and MSs.
- 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 MS 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.

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 should be located only in the closet.

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.

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.

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

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.

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.

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 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 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

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.

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 ten fiber strands and be placed in conduit. The cable must meet or exceed FDDI ANSI Standard X3T9.5 requirements for 1 Gbps transmission.

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 Server (MS), and between the MS 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 LEA'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. Provide personalized programming for each system within the LEA.
2. Provide personalized training for all users within the LEA.
3. 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 LEA.
- 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 an LEA-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 strict. 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 server. 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 server 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 server 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 server 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 server to each telecommunications room for voice circuits. Trunk cables must be sized to accommodate all telephone system requirements.

Guidelines - Data/Computer Network Systems

- The data network should provide a "high speed" ethernet local area network to all buildings within the LEA, 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 server. 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.

- 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, playscapes, entrances, parking lots, commons areas, 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.

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.

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 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 playscape and bus drop-off/pick-up. 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.

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.

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 and MP3 player unit, mic mixer, mic inputs, and 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 – Security System

NOTE: Security systems and operations must meet the current version of the Connecticut "School Security and Safety Plan 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.
   - 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

Guidelines – Security System

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 LEA. 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 an LEA-wide basis via the wide area network, where available.

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.

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 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

Guidelines – 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.

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 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 in the 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. Recommendations include 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.