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VOL. 2. DESIGN STANDARDS -- TECHNICAL CRITERIA

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4. Glazing Study (reference)

VOL. 2. DESIGN STANDARDS -- TECHNICAL CRITERIA

The following Standards may be modified with approval of the District in advance where projects are planned to be constructed under hardship status.

1. ARCHITECTURE

1.1 GENERAL

This section deals with the overall site and building elements that are usually included in the architectural construction documents. Where reference is made to "District" or "District representative" for review or approval, it refers to the District's authorized project representative.

Architect Definition: The term "Architect" refers to the entire design team – the architectural firm and all engineering consultants, specialty consultants, and their personnel. The term "architectural personnel" refers specifically to the members of the architectural firm assigned to the project.

Interdisciplinary Coordination: Requirements of individual sections of this Manual frequently interact with other sections. Because the architectural discipline is responsible for the coordination and compliance of all work, architectural personnel must assure the full communication of design conditions and requirements to the other disciplines and be certain the other disciplines are in compliance. The architectural personnel must also be familiar with the requirements for the other disciplines to be certain their needs are incorporated into the design. Such items include space requirements, wall openings, mounting capabilities, mechanical and electrical services. If discrepancies in the requirements of this Manual are found, bring them to the attention of the District representative for resolution.

Specifications: Specify the work described in the following sections in accordance with CSI Masterformat 2004 Edition, Divisions **3** thru **14,** or per Division numbers defined in each technical section.

Seismic Bracing and Anchorage: The Architect is responsible for assuring that adequate provision is made for seismic restraints, anchorage or bracing of all casework, display cases, equipment, signage, or special finish materials (e.g., suspended ceilings), including Owner Furnished items, in accordance with requirements of the California Building Code.

1.1.1 MANUFACTURERS

- The manufacturers identified in this Design Manual are the District's preferences because of functional and economic benefits, operational familiarity, or inventory

and replacement convenience. They establish a standard of quality and interchangeability with existing District systems. However, the District intends to encourage competition, and, wherever possible, to specify at least three manufacturers (unless an item is defined as “only” or “no substitutes.”). If any difficulties are encountered in providing equivalent products to meet this goal, consult with the SBCUSD representative for resolution.

- When more than one item of material or equipment is specified, as in “three or more manufacturers,” provide adequate facilities and coordination to assure that all spaces are sized to accommodate any item specified and that structural, mechanical and electrical elements will provide adequate support to any of the items. Drawings must be specific as to which requirements apply to which products.

1.2 MATERIALS AND FINISHES GENERAL REQUIREMENTS

Provide materials that are sustainable, affordable, durable, aesthetically pleasing, and that require minimal cleaning and maintenance.

Use standard systems and materials in standard sizes produced and readily available from manufacturers.

Avoid complicated special details.

To the extent consistent with budgetary limitations, use materials that are low in emissions, recyclable, recycled, or otherwise compliant with the principles for sustainable design and expressed in the criteria of the “Collaborative for High Performance Schools” (CHPS).

Use vandal-resistant and graffiti-resistant materials and finishes on all surfaces exposed to the public, interior and exterior.

Provide tamper-proof screws at signs, windows, and other vulnerable and accessible items.

Provide heavy or permanent (fixed) trash receptacles.

Provide non-slip surfaces for all exterior paths of travel and for interior floor areas specifically subject to wetting.

Treat exposed and visibly prominent building elements (such as grilles, pipes, ducts, or similar elements) that are accessible to vandalism so they blend with the building exterior to avoid creating attractive targets.

Provide surface reflectance values of 85% for ceilings, 60% for walls, and 20% for floors in classrooms, to improve task and overall illumination.

1.3 BIRD AND PEST CONTROL

Birds provide a continuing unsightly and unsanitary problem for school maintenance. Cleaning droppings and acid washing stains can cost thousands of dollars per year.

Planning and design must emphasize measures to prevent birds' congregating, perching and nesting on building elements. Such elements include:

- Open beams and flanges
- Exterior sun shades, lattices, light shelves, and other projecting building elements
- Window sills and other recesses greater than three inches or sloped less than 45 degrees
- Scuppers and overflow outlets
- Fresh air intakes and economizer overhangs on HVAC units
- Unenclosed eaves, overhangs and covered walks
- Exposed piping, ducts or conduits
- Exterior lighting fixtures

Bird exclusion methods for building design include:

- Avoid above conditions wherever possible.
- Make angle of any roosting ledge or surface 45 degrees (35 on smooth metal surfaces).
- Screen eaves, vents, equipment overhangs or recesses, and other openings to potential nesting areas, with 1/4-inch mesh hardware cloth.
- Use innovative designs for metal sun shades or light shelves to eliminate roosting sites or to slope greater than 35 degrees.
- Use parallel or grid-wire (line) systems only with DISTRICT approval.
- Do not use porcupine wires (Cat Claw, Nixalite), Ecopic, or Bird Barrier) to prevent roosting without specific DISTRICT approval.

Where building walls abut planting areas, and where recommended by geotechnical or other consultants, provide a 4"-thick concrete apron 6" to 24" wide to reduce moisture penetration to underground building surfaces and to prevent root and pest access to walls.

Locate shrubs and trees so mature crowns do not touch building walls or roof overhangs. If rodent access is prevalent, locate so that crowns are five feet from the building elements.

1.4 SITE ELEMENTS AND SIGNS

Flagpoles: One at each school: 35'-0" for one-story buildings, 50'-0" for two-story.

Signage:

- Investigate school site signage requirements, and coordinate disparate requirements to minimize number of signs
- Show locations and provide details for school exterior signs.

- ∞ Materials and installation methods shall be vandal resistant.
- ∞ All directional and code required signage shall conform to latest edition with all applicable codes including, but not limited to current CBC requirements.

Manufacturer::

Site Signs: Karman, Express Signs, Sign Arts or Fragoso

Interior Signs: Vomar, ASI, or Sign Arts Co.

1.5 METALS

Exterior Handrails: Unpainted galvanized steel pipe of standard manufacture. Vertical steel tubes and/or pipes are preferred to deter climbing on fences

Louvers: Exterior: 12- to 14-gauge galvanized steel or extruded aluminum
Interior: 16-gauge.

Fencing: 8'-0" minimum height galvanized chain link fencing and gates, except for main entries, or special public exposures where fencing that is more decorative would be appropriate (with District approval).

1.6 MOISTURE RESISTANT PROVISIONS

1.6.1 ROOFS:

Roofing: Modified Bitumen or Metal.
Meet UL requirements for Class "A" fire rating.
Comply with FM 1-90 wind uplift rating.

Energy: Use "Cool Roof" criteria, as defined in Title 24, California Energy Code.

Slope: 1/2" per foot minimum to drains.
Show drainage patterns and elevations on roof plans.

Drainage: Place downspouts in 24" x 24" x 4"dp. min. sumps (i.e. splash blocks)
Do not use internal sheet-metal gutters or downspouts.
Do not dump downspouts onto pedestrian areas.
Direct downspouts into planting areas that will slow run-off.

Penetrations: Do not use pitch pans.
Provide flashing that is detailed for each condition.
Do not run pipes, conduit or cables on or above roofs.
Provide vandal-resistant caps on all roof vents.

Hose Bibbs: Provide in locations adequate to serve HVAC units with 25-foot hoses.

Roof Access: Provide from interior spaces, such as, where space permits, custodial closets, not by exterior ladders.

Manufacturers:

- Roofing: Henry Cool Roof System
- Drains: Zurn or Smith bodies with vandal-proof domes.

1.6.2 BUILDING WRAP

Wrap buildings with a weather resistant barrier of polyethylene or polypropylene (typically, Typar or Tyvek Commercial), not building paper. These materials provide much greater assurance of resisting moisture intrusion and remove a nutrition source for mold.

1.6.3 CONCRETE SLABS ON GRADE

At concrete floor slabs on grade, provide, as a minimum quality standard, especially over hardwood, VCT, sheet vinyl floors, where required by Soils Investigation and/or Foundation Recommendations, a vapor barrier of 10 mil thick HDPE with taped or sealed joints, over a layer of 2” of sand atop 4” of select gravel drainage fill. A 2” of sand cover is also suggested to avoid puncture during slab preparation.

1.7 DOORS AND ENTRYWAYS

Door swings shall not over lap, conflict or otherwise interfere with use of adjacent doors or other areas requiring access.

Exterior doors shall be out swinging and protected by a covered walk or canopy with appropriate roof drainage.

All exterior entrances shall be designed to allow safe access during stormy weather (rain, hail, snow, or ice) by providing a walking surface that is no slip, code-compliant, and sloped for drainage.

Exterior balconies:

- Provide security at entryways to balconies to prevent unauthorized access when school is closed
- Provide slopes and drainage means for washing down of balconies and channeling runoff from them
- Do not allow runoff from washing or incidental rain to drain to pedestrian areas below.

At all major or frequently used entries, provide permanent walk off mats to reduce the amount of dirt, dust, pollen and other particles entering the building.

Configure major entry approaches to channel foot traffic away from dirt and grass areas for at least the last fifteen to twenty feet prior to entering the building.

Provide concrete slab or equivalent surfacing outside of all exterior doors, of width sufficient to take doorstop when door is opened 180 degrees against building wall.

Do not provide glazed openings in exterior doors. Do not provide sidelights that, if broken, provide access to door hardware.

Locate exterior doors away from windows or other glass areas that can be broken to provide access to door hardware.

Locate doors to avoid interference with drinking fountains, downspouts, light fixtures and switches, walk ramps, and other building components or equipment.

Double doors at building exteriors shall have a removable center jamb for more secure engagement of the locking mechanism.

Interior double doors should have a removable center jamb unless the full width of the opening is necessary to pass equipment.

1.7.1 DOORS AND FRAMES

Door Type: Solid-core wood doors at interior and overhead protected exterior openings (e.g., covered walks).

Hollow metal steel doors at unprotected or minimally protected exterior openings or where otherwise needed.

As required for wall fire rating.

Door Frames and Cased Openings: Hollow metal. 16-gauge welded, exterior galvanized. No Knock-down frames, unless approved by the District. No surface mounted attachment permitted, All attachments shall be countersunk and filled.

Hollow Metal Doors: exterior 16 gauges, galvanized, Interior 18 gauge, lock, hinge and closer reinforcement, top closer channel, polystyrene filled.

Wood Doors: Solid Core. Paint grade, except in areas of low abuse with special design conditions (administration areas, for example) where stain grade may be used.

Manufacturers:

- Hollow Metal: Curries, Steel craft, Security Metal Products, Stiles Custom Metal
- Overhead Doors: Cookson.
- Wood Doors: Weyerhaeuser, Simpson

1.7.2 DOOR HARDWARE

Doors with panic hardware: Minimum width 3'-4" or as otherwise required to meet handicapped accessibility requirements. Doors with removable mullions shall not have surface or concealed top and bottom rods. Where top and bottom rods are required use only hollow metal doors.

Panic hardware on wood doors: Surface mounted with no bottom rod.

Door Hinges: Full length at heavy use interior and exterior doors. Where light use is expected such as administrative areas, 5 pin full mortise hinges, 1-1/2 pair per leaf shall be used.

Door Closers and Stops: Provide at all doors except for those to private offices, service rooms, and similar secondary spaces. Use wall stops wherever possible with hold open

devices where allowed by code. Use door closers are required for climate or security control or code. All doors with closers shall have continuous hinges or ball bearing hinges. Where closers are provided on glazed doors, provide head rail of sufficient depth to avoid drop plates and other unsightly hardware.

Use bug sweeps on doors to food-preparation areas. Provide kick plates on the push side of wood doors. Provide mop plates on pull side of wood doors leading from areas with non-carpeted floors.

Provide Pemco Door Shoe in lieu of Pemco Door Sweep (3.5 cm)

Do not use electric door openers for ADA accessibility without prior District approval.

Key Schedule: Keying is critical. Develop key schedule for prior District approval during design. Specify Platinum keyway at sites where currently in use, otherwise Sargent "A" Series (Restricted Keyway). Exercise car to explain to stakeholders the function of specialized locksets and keying prior to bid,

Manufacturers:

- Hinges: Roton, McKinney TA 2714, Stanley BB 1279 NRP, or Hager.
- Closers: Sargent 351 Series, LCN 4041.
- Exit Devices: Sargent 3828F with rim cylinder trim kit. Sargent 88 Series.
- Interior handles: Marks Lever 195S Series 26D Finish with 4-7/8 inch strikes for lever locks.
- Keying System: Sargent "A" Series (Restricted Keyway) (Platinum keyway at sites where currently in use.).
- Hold Open devices: Builders Brass
- Door Stops and Holders: Builders Brass
- Kick and Mop Plates: Builders Brass
- Pushes and Pulls: Builders Brass, Forms and Surfaces
- Weather-strip: Pemko
- Smoke Seals: Pemko
- Door Coordinators: Builders Brass
- Astragals: Builders Brass or by door manufacturer
- Thresholds: Pemko

1.8 WINDOWS AND OPENINGS

1.8.1 WINDOWS AND FRAMES

Windows: Hollow Aluminum, natural anodized or as approved by District (or double-hung or single-hung in special cases)

Awning out swinging windows must not intrude into circulation areas to cause a hazard.

Provide a minimum of one operable 30"-wide –minimum window in each classroom that can be used both for ventilation and for emergency egress.

Windows shall not be less than 3'-0" above floor in secondary schools or in elementary school classrooms above the first floor. In no case shall windows extend to the floor. Classroom windows shall be located to provide no direct sunlight and shall be located to avoid student distraction, i.e. suggest locating window sills above height of eye while students are sitting.

Do **not** use large glazed openings. Size openings and glass selection to eliminate intrusion. Aluminum storefront products may be used only upon prior written approval of the District. All glazing frame assemblies shall be uniform among all classrooms wherever possible to simplify fabrication and minimize cost.

Day lighting calculations are mandatory to optimize percentage of natural light for each instructional area based on climate, exposure, glare and sun protection, heat gain and loss and other factors.

All standard classrooms shall have glazing facing north if at all possible.

Stops shall be removable only from interior using vandal proof screws. Exterior stops shall be integral with frame.

Insect screens must be installed on all operable windows, mounted on the inside of windows.

Manufacturers: EFCO 2700, Traco TR-2500, 7225 Series

1.8.2 GLAZING AND LIGHT CONTROL

To optimize both day lighting and energy conservation, use monolithic ¼" glass with a Visible Light Transmittance (VLT) of approximately **0.50** and a Solar Heat Gain Coefficient (SHGC) of approximately **0.50**. These glasses typically have a blue-green tint. Use laminated glass for security and vandalism protection where approved in writing in advance by District.

> Testing by Sempra Energy demonstrated that they provide an optimal combination of visible day lighting (to reduce electric lighting energy) with solar shading for energy conservation (to reduce HVAC energy use).

To provide adequate day lighting for classrooms, use a window-to-wall ratio of approximately 40% subject to day lighting calculations. Use high windows for day lighting, lower windows (3'-6" to 7'-0" max.) for view windows, depending on grades served.

> California PIER-sponsored research by the Heschong-Mahone Group concluded that students in the classrooms with most day lighting, with views, progressed much faster on standardized math and reading tests than those in minimally day lit classrooms.

Provide innovative solar-control devices to block direct sunlight from desktops and to reflect daylight onto ceilings: E.g., exterior light shelves or louvers, interior light shelves, Venetian blinds with blades reversed. (Exterior projections must conform to bird-control measures.)

Other glazing combinations may be considered by the District if they can be justified with life cycle cost and energy savings.

Do not use thermal insulating glass (TIG, or dual- or triple-glazing) without lifecycle cost and energy-saving justification **and prior** District approval. Compared to tinted monolithic glass, energy savings are minimal; cost is excessive (both initial and replacement), and noise reduction is minimal or non-existent.

> Computer simulation studies comparing different glazing types have shown that, compared with tinted monolithic glass, TIG saves less than 3% of total annual energy use, and costs two to three times as much in first cost – plus similarly high replacement cost. And TIG units, unlike monolithic glass, are subject to edge-seal failure and fogging.

If justified by acoustic and or security or vandalism considerations, laminated glass may be used. Special acoustical glazing may be used where needed and must be designed by an acoustical consultant.

For interior windows needing higher security level, use laminated glass.

For light control, provide Venetian blinds on all classroom, library, and office windows – 2-inch blinds in classrooms, 1-inch in offices.

Manufacturers:

- Sealants and caulking: Vulkem.
- Venetian blinds: Levelor Riviera, #112 Alabaster Color, C-90 cord, cord tilt
  Hunter Douglas Contract H2TN(School Blind)
  1-inch: .008 Slat, 15.7 slats per foot min.
  2-inch: .011 Slat, 7 slats per foot min.

1.8.3 WINDOW SECURITY

All windows accessible from the exterior shall have special security measures to prevent building access by breaking glass and entering through the window or by reaching door or window hardware. Accessible windows include any windows with bottom sills less than 10’ above grade or face on balconies, roofs with any portion lower than 10’, or other access points. Measures include grills or closely spaced mullions or muntins. Generally mullion or muntins spaced more than 1 foot in one direction are subject to easy intrusion unless laminated or wire glass is specified or other intrusion protection devices are specified.

Provide closely spaced mullions or protective custom bars or grills that are integrated compatibly with the building design, to prevent breaking and entering.

Grills, if provided, must be operable at emergency egress windows.

1.8.4 SKYLIGHTS

Consider skylights for day lighting of instructional areas, corridors, and public spaces. Provisions must be made for physical security and for room darkening, as well as daylight controls for electric light switching or dimming as well as glare elimination and heat gain minimization.. (See especially provisions for gymnasium lighting in the ADM section “Electric Power and Lighting.)

1.8.5 LOUVERED OPENINGS

For most classroom HVAC systems, a large, louvered air relief opening must be provided in the exterior wall of each classroom (and sometimes a smaller outside air intake opening). These openings must be realistically sized based on the HVAC design and incorporated into the design of the façade or static pressure build-up will prevent classroom door closers from working properly. (In general, do not use exhaust fans to provide relief, for both energy efficiency and acoustical reasons.) **Coordinate with Mechanical Engineer.**

1.9 SUSPENDED ACOUSTICAL TILE CEILINGS

Purpose: Sound absorption for reverberation control, light reflectance for illumination efficiency, utilities concealment,

- Noise Reduction Coefficient (NRC): 0.70
- Light Reflectance: 0.85

Classrooms without suspended acoustical ceilings: Provide equivalent sound absorption and light reflectance characteristics in room.

Provide appropriate markers for tiles that have access to serviceable equipment.

Do not support any above-ceiling equipment or materials on ceiling grid.

Manufacturer:

Grid: Chicago HD Series 200-01, 24” X 48”

Tile: Armstrong School Zone Fine Fissured, NRC 0.70, Light Reflectance 0.85

1.10 WALL AND FLOOR FINISHES

1.10.1 GRAFFITI-RESISTANT FINISHES

All non-painted exterior finish materials up to a height of 10 feet above adjacent horizontal accessible plane must be provided with a District-approved graffiti resistant coating unless otherwise approved in writing by the District.

Stucco surfaces or similar finishes that are accessible from grade or are otherwise graffiti susceptible shall be painted (not integrally colored) and separated by metal dividers into relatively small sections that can be easily repainted to cover graffiti so that slight differences in paint color will not look patched. Standard stucco control joints of 20 foot in each direction are acceptable.

1.10.2 FLOORING FINISHES

Basic flooring material: Vinyl Composition Tile (VCT), 12” x 12”, 1/8”-thick, over leveling underlayment of polymer portland cement, or other District approved floor leveling methods. Where approved in writing by District underlayment grade AC plywood may be used on floors without concrete slabs

ALTERNATE to VCT: Polished and hardened concrete flooring with light coloring and 800-grit polish, sheet vinyl, or other District approved products.

Rubber base.

For flooring in instructional areas and corridors, use brown, black or medium colors and tones, which are easier to maintain than light colors. Maintain light reflectance of 20% or more. If at all possible limit base colors to one per project. Use top set base for VCT floors and carpet (toeless) base for carpet floors.

Do not use sheet vinyl flooring unless otherwise approved by the District. Exercise care in selection of flooring material adjacent to sink areas and in science rooms.

Carpet at such appropriate areas as administration, kindergartens and libraries. Use direct glue down. Do not use carpet pad. Provide static resistant carpet. Carpet tiles may be specified with prior written approval of the District.

Ceramic tile floors (and walls) in student and large public restrooms. Ceramic tile on floors in shower and locker, toilet rooms must be slip resistant. Unless otherwise approved by the District, provide full height tile on all walls in student restrooms, shower rooms; wainscot in faculty rest rooms on at least walls containing fixtures

Quarry tile floors with coved base in food service areas.

Wood sports floors in the gymnasium with venting base.

Wood flooring at multipurpose room platforms, dance rooms, stages shall be as recommended by the Architect.

Multi-use resilient sports flooring: In multi-use rooms that are used for PE and dining.

Manufacturers:

Vinyl Composition Tile (VCT)	
	Armstrong Imperial Texture (Color: 51858 Sand Drift White.) Azrock Premium
VCT Underlayment	W.W.Henry Co. 345 “Milkless” Flooring Underlayment Powder
Rubber Base:	Burke 4-inch TSB, Brown (502), Black (701)
Ceramic Tile:	America Olean, Dal-Tile or Latco
Resilient Sports Floor:	TBD by Architect. . . . .
Wood Gym Floor:	TBD by Architect.. . . . .
Carpeting:	Bigelow Commercial Type Fairfield II BC 104/3117 *or* Collins & Aikman Plexus Accents II
Carpet Glue:	Durabond #670 Adhesive

1.10.3 INTERIOR WALL FINISHES

Corridor walls finished with drywall: Abuse-Resistant Gypsum Board.

Gymnasium Rooms finished with drywall: Abuse-Resistant Gypsum Board.

Kitchen walls: Fiberglass Reinforced Plastic (FRP) Panels.

Restroom walls: Ceramic tile floor-to-ceiling except as noted above.

Restroom and Shower Room floors: same as for walls: (Terrazzo is also acceptable.)

Manufacturer:

Ceramic Tile:	America Olean, Dal-Tile or Latco

1.10.4 PAINT FINISHES

Exterior Paint: Acrylic, Semi-gloss.

Interior Paint: Acrylic, Semi-gloss

Provide surface reflectance values of 85% for ceilings, 60% for walls, and 20% for floors in all instructional areas, to improve task and overall illumination.

Manufacturer:

Paint (100% Acrylic): Vista	Dunn Edwards, ICI Dulux, Spectra-Tone, or

1.10.4.1 Colors

Because the classroom becomes a background for the display of students' work, color schemes should be simple and minimal. However, be reminded most student work is produced on white backgrounds, so some contrast is valuable and encouraged to provide visual interest when the tack surfaces are not covered.

In general, limit the number of interior paint colors to six for smaller schools. In individual classrooms, limit the number of different paint colors to two, and the number of different classroom color schemes to two or three. Ideally, for maintenance ease and aesthetic continuity, all base color in a school would be the same, all accent (trim color and door colors) would be the same, all similar classroom colors would be the same (i.e science classrooms would have the same color scheme, standard classrooms would have the same different color scheme, etc.).

When using bold colors, limit them to trim or accent features.

In selecting colors of factory finished items, such as folding partitions, use reasonably neutral colors to allow flexibility for future color scheme changes.

Ceilings, in general, shall be white, and especially in classrooms, restrooms, and similar rooms.

Paint Colors: Following are the District's standard paint colors. Alternate palettes and accent colors may be selected for District review and approval.

- Exterior wall: Vista Paint Acriglo Semigloss "SBCUSD Hickory"
- Exterior door: Vista Paint Acriglo Semigloss "SBCUSD Burgundy"
- Exterior trim: Vista Paint Acriglo Semigloss "SBCUSD Acorn"

- ∞ Overhangs: Vista Paint Acriglo Semigloss “SBCUSD Antique White”
- ∞ Interior walls: Vista Paint Acriglo Semigloss “SBCUSD Antique White”

1.10.4.2 Palettes

Acceptable palette samples are available for review in the Building Services Paint Shop, to be arranged by the District representative.

With special District approval, high schools and some middle schools may have “spirit” colors as accents/ door/trim custom colors. Custom colors for high schools only.

1.11 SPECIALTIES

1.11.1 GENERAL

Gymnasium Divider Curtains: Vandal-resistant.

Whiteboards: Porcelain on Steel Marker Board, White.

Tackboards: Fine Grain Colored Cork.

Tackable Wall Panels: Vinyl- covered (21-oz.) tack able wallboard.

Tackable Wall Panels (ALTERNATE): Fabric-covered (sisal) tack able wallboard.

Mirrors: Ensure that mirror heights are proper for various uses and grade levels.

Directory Board: Provide a large directory board with map at or near main entry. Show layout of buildings, offices and special facilities in order to orient school visitors.

Manufacturer:

Whiteboard: Platinum Visual Systems (Div’n. Of ABC School Equipment); or Tri-Best.

Tack board: Platinum Visual Systems - natural cork color, or colored vinyl subject to district approval.

Tack able Wall Panel: Platinum Visual Systems.

1.11.2 CASEWORK

Conform to Woodwork Institute (WI) Manual of Millwork: Custom Grade and Laboratory Grade with Certified Compliance Program (CCP).

Surfaces including edges: Plastic laminate.

Cores: Particleboard or fiberboard with formaldehyde-free binder and water-resistant for laboratory casework.

Hardware: WI-approved products. Heavy-duty wrap-around hinges. Locks with keys to match building keying system.

Display Cases: Avoid large glass sizes at hazardous locations, or glass below 3'-0." Provide laminated glass doors without frames with locks. Provide interior illumination for contents.

1.11.3 TOILET SPECIALTIES

Toilet Compartments: Solid Plastic Phenolic Resin. Manufacturer: Santana with 8 inch hinge and full length metal (aluminum) wall brackets. Torx tamper-proof-head fasteners, stainless steel connectors, paisley color or colors as selected and approved by District. Single-robe hook, Surface-mounted, Bobrick B-7671 or equivalent.

Toilet Accessories:

ITEM	STUDENT	FACULTY/ ADULT
Toilet Tissue Dispenser	Interfold Single-sheet Single-fold Toilet Tissue Dispenser Surface Mounted White Enamel Mfctrs.: ∞ Waxie 851370c ∞ Bobrick B-272	Two-roll Side-by-Side Dispenser Controlled Delivery Chrome or Aluminum Finish Surface Mounted Mfctrs.: ∞ Waxie 851220c ∞ Bobrick B-274
Alternate: **Toilet Tissue Dispenser**		Jumbo Roll Tissue Dispenser Plastic See-through Cover Mfctrs.: ∞ Waxie 851158 ∞ Bobrick
Paper Towel Dispenser	Double-fold Towel Cabinet Surface Mounted Mfctrs.: ∞ Waxie 850510c ∞ Bobrick B-262 *(For single toilet rooms, kindergarten & early education center toilet rooms; and classroom sinks))*	Double-fold Towel Cabinet Surface Mounted Mfctrs.: ∞ Waxie 850510c ∞ Bobrick B-262
Alternate: **Paper Towel Dispenser**	"No-Touch" Roll Towel Dispenser Surface Mounted Plastic See-through Cover Mfctrs.: ∞ Waxie 850557 ∞ Bobrick B-262 *(For single toilet rooms only.)*	"No-Touch" Roll Towel Dispenser Surface Mounted Plastic See-through Cover Mfctrs.: ∞ Waxie 850557 ∞ Bobrick B-262
Seat Cover Dispenser	Half-fold, 16 x 12 x 3 inch. Surface Mounted White Plastic Mfctrs.: ∞ Waxie 851560 ∞ Bobrick	Half-fold, 16 x 12 x 3 inch. Surface Mounted White Plastic Mfctrs.: ∞ Waxie 851560 ∞ Bobrick

Soap Dispenser	Cartridge Liquid Soap Dispenser Surface Mounted Mfctrs.: ∞ GOJO Dermapro 800ml Push-Pak ∞ Waxie 380143	Cartridge Liquid Soap Dispenser Surface Mounted Mfctrs.: ∞ GOJO Dermapro 800ml Push-Pak ∞ Waxie 380143
Alternate: **Soap Dispenser**	Cartridge Liquid Soap ("Push-Pak") Dispenser Surface Mounted Black Plastic Finish Mfctrs.: ∞ GOJO Dermapro 800ml Push-PaK ∞ Waxie 385905	Cartridge Liquid Soap ("Push-Pak") Dispenser Surface Mounted Black Plastic Finish Mfctrs.: ∞ GOJO Dermapro 800ml Push-Pak ∞ Waxie 385905
Waste Receptacle	Floor Standing Open Top Black Enamel Mfctrs.: ∞ Bobrick B-2260	Wall-recessed Stainless Steel Mfctrs.: ∞ Bobrick B-3644
Sanitary Napkin Dispenser / Vendor ***(Middle and High School Toilets Only)***	Surface Mounted Mfctrs.: ∞ Bobrick B-282-25 *(For Middle and High School Only)*	Surface Mounted Mfctrs.: ∞ Bobrick B-282-25
Sanitary Napkin Disposal ***(Middle and High School Toilets Only)***	Surface Mounted (Recessed in ADA stalls) Stainless Steel Mfctrs.: ∞ Bobrick B-270 Contour Series ∞ Bobrick B-4353 in ADA stalls ∞ Waxie 820705 *(For Middle and High School Only)*	Surface Mounted (Recessed in ADA stalls) Stainless Steel Mfctrs.: ∞ Bobrick B-270 Contour Series ∞ Bobrick B-4353 in ADA stalls ∞ Waxie 820705
Grab Bar	Stainless Steel Tubing, 1 ½" diam. 18-gauge Satin Finish Surface Mounted Mfctrs.: ∞ Bobrick B-6806 ∞ *(For ADA-compliant stalls & single toilet rooms)*	Stainless Steel Tubing, 1 ½" diam. 18-gauge Satin Finish Surface Mounted Mfctrs.: ∞ Bobrick B-6806 ∞ *(For ADA-compliant stalls & single toilet rooms)*
Mirror	Stainless Steel, 18"w. x 24"h. Mfctrs.: ∞ Bobrick B-1556, 18" x 24" ∞	Framed Glass Mirror Mfctrs.: ∞ Bobrick B-290 ∞

Shelf		Stainless Steel Shelf Surface Mounted Mfctrs.: ∞ Bobrick B-296

Note: ADA-accessible toilet compartments must be made wide enough to accommodate the District's choice of tissue dispensers, and where required surface mounted sanitary napkin disposals are the only options.

Hand Dryer (in multiple student toilet rooms): Electric recessed hand dryer, Pinnacle Dryer Corp., PDC-R10 (specify with Toilet Accessories, not in Electrical sections).

Provide paper towel dispenser and disposal and soap dispensers at every classroom sink.

1.11.4 CONVEYING SYSTEMS

Elevators shall meet access compliance requirements. Locate adjacent to or no greater than 200 lineal feet of travel from required stairways. Elevators shall have controls via access cards when required by the District.

Except as required for the elevator itself, no electrical, plumbing, sprinkler heads or mechanical items shall be housed in elevator shaft, pit, or machine room.

Design pit to prevent water from entering through walls or floor.

Provide a permanent galvanized unpainted steel ladder in pits over 36" in depth.

Vandal Protection: For elevators that open to the exterior or to unsecured arcades and balconies, provide a vestibule equipped with a 3'-8" minimum solid-core door with classroom type lockset.

Manufacturer: Wheelchair Lifts: Lift-U.

Division of Hogan Mfg., Inc. PO Box 398, Escalon CA
937-836-6901, www.liftu.hoganmfg.com

2. CIVIL ENGINEERING

2.1 GENERAL REQUIREMENTS

The civil engineering site design and documents must implement the provisions of the overall site design, integrating the requirements of buildings, walls and fences; grading and paving; storm-water management; utilities (including gas, electrical and communication network distribution locations); earth and soil requirements (including compaction, modification, topsoil, and mitigation of hazardous ground conditions); as well as all offsite work related to the project, including streets, driveways, walks, utilities connections, and other offsite development.

All such work shall be clearly delineated, located and dimensioned (horizontally and vertically) to the appropriate site reference, as part of the work of this discipline, and all utilities points of connection (POCs) clearly shown and located – all with easily understood and straightforward dimensioning. Grades, slopes, required cuts/fills shall be appropriately depicted, dimensioned, and defined with both horizontal and vertical dimensions sufficient for accurately calculating cut and fill quantities.

The District will provide the Architect with a current site boundary and topographic survey, with encroachments, including adjoining streets and properties and onsite and public utilities line locations, sizes and elevations. The Architect and their consultants must visit the site prior to submitting their fee proposal to verify the indicated information and to obtain information not indicated on the drawings.

Construction site plans shall clearly show provisions for future expansion, including future building locations and provisions for extensions of utilities systems.

Offsite work or work within easements shall be designed in accordance with the requirements of the authority having jurisdiction. The work shall be shown as part of the construction documentation and shall include all project related offsite improvements, such as curb cuts, street lighting, signals, storm drains, turnout lanes, signage, utility connections, street widening, street vacations, street dedications and non-site adjacent mitigation measures to be included in the design and all other such work.

Construction plans shall clearly identify locations for staging of construction materials, site access for contractor workforce and delivery of materials, and temporary fencing and barricades for site security and safety.

On sites with existing school functions/facilities, construction staging and work areas shall be separated from the school functions/facilities by temporary fencing and/or barricades shown on construction plans.

Specify the work of this section in Division **31 00 00, Earthwork,** and Division **32 00 00, Exterior Improvements,** in accordance with CSI Master format 2004 Edition.

2.2 DEMOLITION

Demolition work must be documented as a separate contract item, with a separate and complete package of bidding and contract documents.

Coordinate any demolition or relocation of utilities and existing improvements, such as fences, walls, structures, etc., that are encroaching into the District property.

Provide temporary fencing to secure property boundaries wherever work might breach closure of adjacent property.

Investigate existing conditions to assure that full extent of demolition work is included, especially with regard to subsurface conditions such as concrete paving overlain with asphalt, building basements, foundations of demolished buildings, and utilities lines. If existing data is insufficient, request potholing or other investigation from the District.

Clearly identify and define in the demolition documents all existing site features (structures, walls, fencing, walks, pavements, site utilities, plants, terrain, etc.) that are (1) to remain, with defined protection measures, (2) to be removed, with the required disposition and responsibilities for removal and/or relocation and (3) contract and demolition limits. Provide post demolition topographic survey update both is electronic and print format.

2.3 GRADING

For ease in staking and construction, grade with uniform planes (not warped surfaces) and minimize grade changes.

Slope all areas for drainage. Slope walks, stairways, ramps, and other surfaces away from buildings. Slope site to public right of way or storm drains. No lift pumps.

Slope planes for drainage typically between 1% and 2% with 1.5% considered optimum.

2.3.1 OTHER SLOPE STANDARDS

Within Building Areas: 1.5% - 2.0%.

Within Play Areas: 2% maximum. 1% preferred.

Entrance Walks and Ramps (along path of travel): 5% maximum, preferably 4.8% maximum for construction tolerance variation (8.33% with handrail).

Driveways: 15%, with vertical curves of 10’ at top and 5’ at bottom of ramp.

Slope along Sliding Gate: 2% maximum for chain link gates, 1% or less for heavier gates.

Walks, Porches, Study Terraces, etc.: Cross fall of 1% to 2% maximum.

Door Landings: ½% to 1% maximum

Paved Lunch Areas, and Similar Areas: ½% to 2% maximum. Shape planes to accommodate tables and benches.

Agricultural Areas: ½% minimum.

Asphalt Paving Flow Lines: 0.75%. If less, use concrete gutter flow line with minimum slope of 0.4%; do not use gutters in striped play areas.

Sloped banks (where necessary): No greater then 15%.

Provide protective fencing and an 18” minimum shoulder at tops of banks sloping steeper than 10%.

2.3.1.1 Play Fields and Play Areas Slope Standards

Turf or lawn areas: ½ % minimum, 2% maximum, ¾% optimum.

Concrete Tennis Courts: 0.83% to 1% maximum, in one plane only, preferably from side to side.

Handball Courts: 0.5% to 1% maximum, in one plane only (when necessary).

Infield of High School Baseball and Softball Diamonds: 0.5% maximum.

Baseball Pitcher Mound: 15" above home plate. (Locate drainage structures to minimize hazards to players.)

Maximum inclination for tracks, runways, circles, and landing areas for throwing events: not over 1:100 in a lateral direction and 1:1000 in the running or throwing direction.

High Jump: not over 1:250 in the direction of the center of the crossbar. See IAAF and CIF Rules for other track dimensions and information.

2.4 PAVING

Provide paving, base and sub base preparation as recommended by the Geotechnical Engineer. Compaction 95% unless report indicates otherwise.

Paving minimum standards include:

- Playgrounds (new construction): 2” asphalted concrete over 4” select base course.
- Playgrounds (resurfacing): 2” asphalted concrete over scarified and compacted asphalted base (or over 3” select base if existing AC is removed).
- Service Roads and Fire lanes: 4” asphalted concrete over 6” select base.
- Parking Area: 3” to 4” asphalted concrete over 6” select base in driveways, 2” to 3” over 4” in parking spaces, as recommended in Soils and Foundation Recommendations for each project.
- Trash Pick-up Area: 6” reinforced concrete over 4” select base (12-foot width).
- Sidewalks: 4” unreinforced concrete.
- Banks: 2” asphalted concrete over compacted sub grade.

Provide for the special paving requirements of bus-loading zones, truck loading and dock areas, trash pick-up areas, and fire lanes.

Pave parkways and narrow strips adjacent to sidewalks at property lines as concrete sidewalks.

Separate asphalt paving from planting areas with a reinforced concrete header, minimum 6” x 6” or other District approved separation such as treated wood or thickened asphalt.

Provide driveway approaches in accordance with commercial driveway requirements of the local governing jurisdiction, with minimum width of 20'.

Provide integral curb and 1'-6" to 2'0"-wide concrete gutter on service roads within bus unloading area.

Provide paving of full width and turning area needed for all delivery trucks and trash pickup vehicles. Also, check width of drive aprons providing access to these areas. Provide turn around area for vehicles to avoid backing up.

Provide 4" wide striping for parking stalls and other roadway markings.

Mark fire lanes in accordance with local fire authority requirements.

Provide ramps for sweepers and mowers to reach raised areas from their storage locations.

2.5 STORM AND SANITARY DRAINAGE

Design site for maximum retention of storm water runoff, within the general limits of local authority, SWPP, WQMP and other code requirements, such as Post Construction Storm Water Management Plans. (See ADM Vol 2 - Plumbing for additional criteria.)

For sanitary sewers, show fixture units at building, street points of connection, and elevations of new and existing lines. Size sewer lines per code prescriptions, or provide hydraulic calculations.

Do not use lift pumps.

A permit is required for each point of discharge to the public sewer and storm drain system. No joint storm/sewer discharge systems are allowed. Local ordinances must be addressed, but the standards required by City of San Bernardino shall be the minimum standard for all SBCUSD schools. Industrial wastewater permits must be obtained from the appropriate City or County authorities.

2.5.1 SURFACE DRAINAGE

Use surface drainage in lieu of underground storm-drain systems as much as possible.

Direct sheet flow from paved areas onto planted areas for greater retention.

Direct roof downspouts into planting areas (via splash blocks) where feasible.

Locate flow lines to avoid concentrations on pedestrian walks.

Locate flow lines to avoid sand boxes, tree wells, and other objects that might obstruct drainage flow and cause water to pool.

Do not drain from planting areas across paved areas.

Do not drain over public sidewalks.

Do not drain over planted or unpaved banks.

Do not drain through or over roofed areas, electric or communication vaults, walk off mats, or other similar functional areas.

Intercept offsite drainage to prevent it from flowing across site.

At interior courts or sump areas near buildings, provide for surface overflow from the court that is 3" or more below finished floor elevations to avoid flooding if catch basins are blocked.

Surface collection ponds are not acceptable except as planned for storm-water retention basins.

2.5.1.1 Catch Basins, Floor Drains and Culverts

All catch basin grates and frames in traffic areas shall be traffic rated bolt-down type. Grate openings: ½" maximum where disabled paths of travel occur.

Offset a catch basin from main storm drain line to minimize its size and depth, and to minimize blockage of system (i.e., no inline "flow thru" type catch basins).

Use cast in place or precast concrete catch basins.

Maximum depth of catch basin: 30", unless specific project approval given in writing by the District.

Use rectangular cast iron or fiber cement pipe culverts under walks in place of formed concrete structures. Provide minimum 4" thick concrete encasement, but with 2 ½" cover under walks. Calculate size for flow.

Do not locate catch basins in the middle of play yards and pedestrian pathways.

Use trench drains only when required; for example, at parking structure entrances.

In trash disposal areas and open lunch areas, provide floor drain and sediment buckets to collect storm and wash-down water. Locate next to hose bib and provide dual drainage, with a diverter valve to flush wash-down water to sanitary drain and storm water to storm drain.

2.5.2 UNDERGROUND DRAINAGE

Drain piping shall be concrete, reinforced concrete ("RCP"), ductile iron ("DIP"), cast iron ("CIP"), or high density polyethylene (HDPE).

Design drainage structures and piping systems based on hydrologic and hydraulic calculations, with minimum flow velocity of 3' per second.

Provide capped stub outs for drains in new construction to accommodate planned future construction.

With less than 1'0" of cover over top of pipe encase pipe in concrete or use iron pipe.

With less than 1'0" of cover over top of pipe in vehicular traffic areas and in asphalt paved areas encase pipe in concrete, reinforced as necessary to support imposed loads.

Food waste drainage from wash-down in covered lunch shelters must flow into sanitary sewer. Rainwater from roofs covering lunch shelters must flow into storm drain system.

Drain trash enclosure and open lunch areas through pipe to storm drain system and to sanitary sewer (using dual drainage valve system described above).

Provide cleanouts at maximum spacing of 100 feet in straight runs, at each aggregate change of direction exceeding 135° (degrees), and at any change of direction greater than 90°. A catch basin may substitute. Install cleanouts in yard boxes.

Where transition is made from round pipe to rectangular pipe, provide cleanout handhold or manhole for maintenance purposes.

Depths of sanitary sewer lines below finished grade shall be not less than 12" and not less than 6' at property lines. (Use greater depth if service to future buildings should require it.)

2.6 WATER DISTRIBUTION

2.6.1 WATER SERVICE

For detailed requirements for water service, valves, and backflow preventers see ADM, Vol. 2, Section 4, "Plumbing." Note requirement for two parallel branches for the domestic water supply.

Meter locations (preferably at the curb) must be approved by the District and the water supplier.

Separate domestic and irrigation meters and backflow preventers by 35 feet minimum.

Contact water supplier for main, pressure and flow information.

Do not use booster pumps without justification and District approval.

At new facilities, provide one (1) meter each for domestic, fire protection, and irrigation water service. See ADM Sections for Plumbing and Planting and Irrigation for gas piping, irrigation service, and other related criteria.

Provide minimum 4-inch pipe for irrigation service.

2.6.2 PIPING AND DESIGN

Provide a water load schedule for each meter including existing, new and future load in fixture units and gallons per minute (gpm). Coordinate with the Plumbing Engineer.

Provide hydraulic calculations for water distribution system. Show water demand and residual pressure at building and street point of connection.

Where pressure reducing valves are required, coordinate location with Plumbing Engineer and with the District.

On domestic water service, provide tandem installations of pressure regulators, backflow preventers and strainers, to avoid shutdown during testing and servicing of equipment.

Provide thrust blocks and ties for bell and spigot piping.

Before specifying piping, review corrosively of soil with the District soils report to verify appropriate pipe material selection.

Specify a means to identify below-grade pipes (color, tape).

Wherever pipe and valve assemblies are exposed above grade, provide a secure locked enclosure to protect them from unauthorized use or vandalism. These may be walls, fences, or manufactured enclosures that are made for this purpose.

2.7 FENCING, WALLS AND GATES

Provide full perimeter fence enclosure for school campus 8’ high minimum.

Provide full perimeter fence enclosure for all parking areas.

Provide full perimeter fence enclosure for athletic fields, with gates to separate public access to events from the adjoining school campus.

Fencing: Chain-link, except for special ornamental fencing and gates for main entry to school and other special areas, which shall have design appropriate to site and buildings.

Fencing at swimming pools: Ornamental metal, with bases of posts 6” above adjoining to prevent wetting and corrosion of fence.

At adjoining residential areas, provide CMU walls, 8’ minimum height.

Provide anti graffiti coating on CMU walls both sides. Avoid split face and other textured CMU such as slump and fluted CMU.

2.7.1 DIMENSIONS AND GATES

Perimeter and Parking Area Walls and Fences: 8’-0” height.

Interior Security Fences: 8’-0” height.

Interior Playground Fences: 4’-0” height

Pedestrian Gates: 6’-0” w double, 4’-0” w single x fence height.

Drive Gates: 20’-0” wide minimum.

Tennis court, hard court and field gates: 6'-0" wide (to accommodate sweepers).

Service Yards: Provide sliding drive gate wherever possible.

Trash Yard: Enclose with solid walls or fencing and gates with integral slats. Locate it for easy access and trash pickup, away from student areas, and out of direct view of neighboring property owners.

Clearances for all gates and doors shall be according to good industry practice and in no case large enough to permit entry or bypassing of security measures.

In general, provide swinging gates rather than sliding. Emergency gates shall be swinging gates. Use sliding gates (cantilevered) at drives and for large openings where normally open swinging gates would cause obstructions.

Gates that require panic hardware shall be at least 7'-0" in height with fixed transom panel to align with fence height and shall have coverings to prevent easy access to panic device from locked side of gate.

Provide sliding gates to control pedestrian traffic into field bleacher areas.

At tops of banks, set fence line away from top of bank 18" minimum if bank is paved, and 24" minimum if bank is not paved.

2.7.2 CHAIN LINK FENCE CONSTRUCTION

Chain link fence shall conform to requirements of the Chain Link Fence Manufacturer's Institute (CLFMI) and Standard Specifications for Public Works Construction (SSPWC) for galvanized steel pipe frames and chain link fabric.

Fabric: Class 2 zinc coated, galvanized after fabrication, knuckled at both selvages, 2-inch mesh, 9-gage wire.

Frames: Pipe, Steel, Round, Hot-Dipped Zinc Coated (Hot-Dipped Galvanized) ASTM F-1083, Welded for Fence Structures, Schedule 40, Class 1.

Frame sizes (minimum diameter): Terminal posts, 3½"; Line posts, 2 3/8", Top rail , 1 5/8".

Hardware: Manufacturer's recommendations, with latches and other accessories to assure a secure gate. Padlock hardware. Knox box for Fire Department access.

Structure, hardware, accessories in accordance with SSPWC and CLFMI.

Manufacturers:

Master-Halco/Anchor Fence Co.

Boundary Fence & Railing Co.

Reeves Southeastern Wire Corp.

3. STRUCTURAL ENGINEERING

3.1 GENERAL REQUIREMENTS

The design for structural safety of school buildings in California is governed by the requirements of the Field Act, beginning with Section 17280 of the Education Code, and by Title 24 of the California Code of Regulations (California Building Code (CBC)).

The structural engineer is responsible for the design, or review and approval of designs, of connections, seismic restraints, anchorage or bracing to the basic structure of such building elements as veneer materials, window walls, non-bearing steel stud assemblies, decorative block screens, casework, display cases, equipment, signage, or special finish materials (e.g., suspended ceilings), library shelving, mechanical and electrical equipment and components, and similar items, including Owner-Furnished items,

The structural engineer shall visit the site and visually confirm the existing conditions as represented on the survey and geotechnical report.

Include the geotechnical engineer name and report date on drawings.

Testing and Inspection (T&I) shall meet the requirements of Title 24. After plans are approved by Division of the State Architect (DSA), submit one copy of the DSA Tests and Inspection List to the SBCUSD Facilities Program Management Team.

Provide seismic anchorage and bracing details, supported by structural calculations of all fixed equipment as required by DSA.

3.2 DESIGN CRITERIA

3.2.1 CODES AND GENERAL REQUIREMENTS

The governing building code for structural design is the current edition of the California Building Code with modifications by the Division of the State Architect/ Structural Safety Section (DSA/SSS) for school design and construction.

The requirements of the California Building Code and DSA shall govern except where specifically defined below to be more restrictive.

Roof design loads shall provide for the weight of one re-roofing if the roofing designed can be re-roofed without removing the original roofing.

Uncovered open frame roof structures shall be designed for a vertical live load of not less than 10 psf of the total area enclosed by the framework.

Deflection: Maximum allowable deflection for structural members shall be as defined in the CBC, except as follows: To reduce long term deflection and cracking of finished surfaces, where floor members of engineered wood support floor finishes of ceramic tile, terrazzo, concrete or similar materials, maximum deflection shall be limited to L/540.

Indicate on plans key design criteria used, including code edition, seismic design factors, and soil profile type.

3.2.2 BUILDING SYSTEMS

The following criteria and suggestions reflect policies and preferences of the District derived from experience with economy and durability. Exceptions may be made with justification and specific authorization of the District Project Manager.

School buildings that are 3-story and higher shall be steel framed with floors of concrete on metal deck supported by composite beams, or of reinforced concrete. The lateral force resisting system should be special concentric braced frames or the most cost effective system allowed by current codes. Avoid moment frames; which generally are expensive and allow story drift that makes it hard to prevent damage to typical school wall finishes.

Gyms and auditoriums preferably should have masonry or concrete walls and steel framed roofs with steel decking without concrete fill but may be timber construction walls and roofs where necessary to meet budget constraints.

3.3 CONCRETE AND MASONRY STRUCTURES

Use a minimum concrete ultimate compressive strength of 3000 psi at 28 days.

Concrete mix design must comply with CBC Section 1905A.2.3; Method B is commonly used for typical school building projects.

Use fly ash to replace portland cement, minimum of 15%. Use higher percentage, up to 35%, for workability, higher density and greater strength.

Specify size of aggregate and slump. Use 1” or ¾” minimum aggregate size, with smaller sizes only in very special cases.

Control cracks in concrete by joints, construction joint separations, and other means.

Avoid thin sections or projections that may crack off when forms are removed. Chamfer column and other corners as well as exposed edges. Provide drips.

Provide typical construction joint locations for concrete beams, joists, and slabs.

Provide expansion joints, control joints and seismic movement joints as required by the design, indicate their locations and details on drawings, and coordinate with architectural enclosures and finishes.

Joints must be weather tight and provide lateral stability across the joint.

Where a concrete beam is monolithic with a concrete wall and negative beam reinforcing steel is embedded in the wall, include a detail that shows the preferred pour line and alerts the contractor not to pour wall without negative reinforcing in place.

Indicate openings, depressions and curbs on structural floor and roof plans. Curbs must be a minimum of 5″ wide if located under walls.

Maintain a full depth of slab under depressions for ceramic tile, electric ducts, or other construction.

Provide a typical column drawing indicating bar maximum slopes, locations of splices, and reglets for shearwall reinforcing.

When setting a rail post use expansive grout or equivalent ("Por-Rok" but not sulfur). Provide a #4 bar on each side of post in concrete.

If wood or steel studs are used in concrete buildings, indicate clear relationship between "face of concrete" and "face of studs."

In masonry walls, base dimensions on modular size of the unit.

In concrete masonry walls, grout all cells except on free standing site walls retaining no earth. Avoid bars larger than #8.

Clearly show the minimum concrete cover required for the intended fire protection rating.

3.4 FOUNDATIONS AND CONCRETE OR MASONRY ON EARTH

Provide special design and recommendations to deal with expansive soils beneath structures.

Make clear on drawings all areas of fill.

Building foundations shall not be partly on fill and partly on natural grade or cut.

Show bottom of footing elevations on foundation plan, including building walls, columns, flag poles, lighting structures, retaining walls, etc.

Provide structural elevations and details of all retaining walls and site walls over 3′-6″ high showing bottoms of footings, steps, joints, sleeves and drainage. Footings may be sloped 5% maximum to avoid steps.

For building walls that retain earth, use a minimum thickness of 10" if reinforced concrete or as approved by the District and provide waterproofing and drainage outside the walls. Coordinate structural design with waterproofing and sub-drain design to assure adequate water resistance.

Retaining walls higher than 12 feet as measured from the top of the foundation shall be designed to resist the additional earth pressure caused by seismic ground shaking.

Floor slabs on grade shall be 5" thick minimum, reinforced with #4 bars at 24″ over crossing each way, with a water/cement (w/c) ratio of 0.45 or lower unless otherwise specified in the Soils Investigation and Foundation Recommendations.

For concrete floor slabs on grade, show the vapor barrier. (See requirement in Architectural Section 1.6.3.).

At exterior walls that abut a planting or earth area, pour a concrete slab against the wall, 24" wide x 4" deep minimum or as specified in the Soils Investigation and Foundation Recommendations, to reduce water infiltrating to below-grade walls or under footings, and to eliminate plant growth that can harbor pests.

Requirements of the paragraphs on “Concrete and Masonry Structures” also apply.

3.5 STEEL STRUCTURES

Show top of steel elevations at each column and change of level on structural drawings for ease of reference by steel detailers and erectors.

Indicate required camber on all tapered steel girders and steel trusses.

Provide erection bracing for tapered girders. Web thickness for all built-up sections shall be at least 3/16". Provide flange-to-web welds to comply with AISC specification. Use stiffener plate welded to top flange and to web where ridge occurs.

Comply with maximum width to thickness ratio requirements of AISC for projecting elements under compression. Apply requirements to railing parts.

For exterior steel work specify sections with a thickness of ¼” or greater.

Specify cost effective size, length and type of welds. Use standard weld symbols and consider fillet welds where adequate.

Make groove welds "full penetration" on structural welds such as tapered girder flanges.

On welded assemblies to be hot dip galvanized, avoid shop welding large areas, such as stair platforms, to prevent warping in galvanizing bath. Field weld and retouch galvanizing, or use cadmium plated counter sunk flat head machine screws for field assembly.

Provide means of leveling for base plates, such as double nuts on anchor bolts.

Do not support steel members with wood columns.

Avoid steel bar joists and truss girders. (Because of DSA special testing and inspection requirements, most steel joist fabricators will not bid DSA jobs.) Custom trusses are acceptable where economies can be demonstrated.

Keep floor steel beam L/d ratios ≤ 24.

3.6 WOOD-FRAMED STRUCTURES

Provide camber in structural members in accordance with DSA requirements. Use a stiffer member in preference to using excessive camber.

Depth-to-thickness ratio of horizontal members shall not exceed 7.

Bottoms of sills on exterior foundation walls shall be not less than 6" above finished grade.

Structural I plywood is preferred. Use at least CD Grade with exterior type glue.

Provide drawings of wall elevations to indicate typical framing. Provide special framing elevations where large openings occur, where columns pass through wall plates, or where framing is otherwise complex.

Provide complete roof framing plans showing walls. Clearly indicate corner framing and slope of roof.

Stud walls or partitions around shower or toilet rooms with more than two fixtures, and stud walls adjacent to exterior ground or paved areas, shall bear on concrete curbs extending at least 6" above finished floor or paving level. Curbs and sills must meet DSA special curb requirements.

On wood joist floors of heater rooms using gas fired boilers, provide 2" thick concrete fill, 6" curbs, and a floor drain on the floor.

Use nominal 6" wide studs for walls unless budget constraints dictate otherwise and District approves change in advance with the exception of nonbearing walls with no piping.

Clearly indicate connection of vertical shear elements to diaphragms. Be sure these shear elements do not produce a high concentration of stress over a small length.

Where pipes pass through top plates, provide a detail on both structural and plumbing drawings.

Use minimum 1/2" thick plywood for roof sheathing. Indicate stagger of panels required for horizontal diaphragms.

Standardize on a few sizes for tie-down bolts -- a mixture of several tie-down bolt sizes can be too easily mixed up on the job and are not cost effective.

4. PLUMBING

4.1 GENERAL REQUIREMENTS

Plumbing systems shall be installed in accordance with the current California Building Code (CBC) in California Code of Regulations, Title 24, as well as CCR Titles 19 and 8, District ADM Volume 2, Technical Criteria, and other sections of this Manual.

Design systems to be simple, durable, easy to operate and maintain, with easy accessibility for servicing, maintenance and replacement, all in a manner that will avoid interruption of educational schedules during working hours.

Conceal and properly secure all piping behind building finishes. (Exception may be made in equipment and custodial rooms of CMU or concrete construction.) Where necessarily exposed in renovation projects, paint all piping and insulate hot water and condensate piping.

Contact each utility supplier to determine the requirements for the most cost effective service connection. Provide separate meters for domestic, fire and irrigation water supplies. See ADM Vol 2, Civil Engineering Section, for additional information relevant to the work of this section.

Lavatories: In student toilets, cast iron with heavy-duty high gloss enamel finish. (Vitreous may be used in staff/adult toilet rooms.) Three-hole 4-inch-center set (no single-hole) faucets.

Classroom sinks: Stainless steel

Service sinks: Cast iron with heavy-duty high gloss enamel finish.

Custodial Room sinks: Cast iron with heavy-duty high gloss enamel finish, floor-mounted corner sinks, with 5-ft. high stainless steel backsplash on two walls.

Water closets: Wall-mounted.

Drinking fountains: Cast-iron with high gloss enamel finish.

Plumbing access panels shall have the same fire rating as the wall or other mounting surface. Call out rating on construction documents.

Fixtures must comply with State water conservation guidelines and standards. Provide flow rates that comply and also meet following standards:

- Water Closets (Flush Valves): **1.1 gpf**
- Water Closets (Tank): **1.1 gpf**
- Urinals: **1.0 gpf**
- Lavatories: **0.5 gpm**
- Showers: **2.0 gpm**
- Kitchen and Service Sinks: **2.0 gpm**

Provide rough-in plumbing for appliances wherever programmed, including locations for washers and dryers in PE areas, in Special Day Centers where specified and Cafeteria. areas.

Manufacturer: Lavatories: Cast Iron, American Standard, Chicago faucet, 4"-center sets

Water Closets, Urinals: Porcelain, American Standard, Kohler (Wall-Mounted)

Classroom Sinks: Elkay, Just, with Haws J#5017 bubbler and Chicago 350 faucet.

Faucets: Chicago

Drinking Fountains: Haws (see above for requirements)

Classroom sinks: Stainless steel, Just, Elkay with Haws Bubbler 5017, Chicago 350 faucet (No Exceptions)

Flush Valves: Royal Sloan Flush (or approved equal)

Specify the work of this section in Division **22 00 00, Plumbing,** in accordance with CSI Masterformat 2004 Edition.

4.1.1 STUDENT TOILET ROOMS

Provide in all student toilet rooms the following features to reduce maintenance, conserve water and minimize student tampering:

- Shutoff valve for all fixtures in each restroom, located in the wall above the upper terminal water closet (when there is more than one) and behind a locked access panel.
- Consider new technology for auto-flush and low-volume flush valves fixtures, review with District.
- Lavatory Faucets: ADA compliant push-button with slow-closing cartridge that closes upon release of push button.
- Hose bib with vacuum breaker in recessed box with locking cover.
- Urinals with stainless steel strainers attached to the drain inlet.
- Floor drains with trap primers and floors sloped to drain.
- Cleanouts above all urinals, lavatories, and water closets (in wall above upper terminal fixture when there is more than one), behind a locked, heavy-gage security type access panel.
- Electric hand dryers in lieu of paper towel dispensers except in kindergartens and early education centers. Nozzles to be fixed in 'down' position. (Specify with "Toilet Accessories" -- see Architectural Section. of ADM)
- A dual GFCI outlet behind a locked access panel.

- Provide 6” concrete curb around all walls of toilet and shower rooms.

4.1.2 STAFF AND VISITOR TOILET ROOMS

Provide in all staff and visitor/adult toilet rooms the following features to reduce maintenance and conserve water:

- Shutoff valve for all fixtures in each restroom, located above the upper terminal water closet and behind a locked access panel.
- Urinals with stainless steel strainers attached to the drain inlet.
- Floor drains with trap primers and floors sloped to drain.
- Cleanouts above all urinals, lavatories, and water closets (in wall above upper terminal fixture

4.2 SEWER AND DRAINAGE SYSTEMS

A permit is required for each point of discharge to the public sewer system. For other jurisdictions, the local ordinances must be addressed, but the standards required by City of San Bernardino shall be the minimum standard for all SBCUSD schools. Industrial wastewater permits must be obtained for clarifiers and grease interceptors from the appropriate City or County authorities.

4.2.1 SEWER LINES

Specify cast iron soil pipe at all following locations:

- Within the building and 5'0" outside the building line.
- Running parallel to and within 2'-0" of any building or structure.
- Within 20'-0" of any tree centerline.
- Not less than 1'-0" below finished grade.

Provide cleanouts above all urinals, lavatories, upper terminal water closets, and sinks.

Provide cleanouts to grade in yard box at:

- Upper terminal cleanout within 5’ of building line connection.
- Every 100’ or change of direction over 22.5 °.
- At property line connection.

Roof vents shall be covered with vandal-resistant covers.

Do not provide cleanouts overhead in parking garages. They are neither manageable nor accessible for use.

Waste piping traps shall be cast brass with polished chrome finish. No tubular traps. Concealed traps and 17-gauge tailpieces may have rough brass finish.

Provide uniform slope of 1/4" fall per foot wherever possible, but never less than 1/8” per foot.

Indicate on plans invert elevations of new sewer lines at buildings, changes in direction, locations where sewer lines join and at property lines. Indicate sizes and inverts of existing utility lines on plans.

4.2.2 PRIVATE DISPOSAL SYSTEMS

When private disposal systems are required and programmed, verify requirements with the local health authorities and obtain written approval.

Clearly define the extent and locations of system elements.

4.2.3 SCIENCE LABORATORY WASTES

Laboratory wastes are defined as chemical or industrial liquid wastes that are likely to damage the public sanitary sewer system, increase its maintenance cost, detrimentally affect sewage treatment, or contaminate surface or subsurface waters. They shall be pretreated to render them innocuous prior to discharge to the sewer system unless an approved “Best Management Practices Program” is in effect at the school.

Provide an independent laboratory waste drainage system to the building exterior for plumbing fixtures in laboratories and associated workrooms which could receive laboratory waste.

Verify requirements from governing agencies and District for neutralizing tank. A sample box with provisions for future neutralizing tank may be sufficient. Where neutralizing tanks are required, piping from lab waste to neutralizing tank and vent piping: Corrosion-resistant material – either Type 316L stainless steel or HDPE or PVC that does not require wrapping pipe in plenums: Flame-retardant Schedule 40 Polypropylene ("Fuseal") preferred. Joints and fittings shall be DWV electric fusion and made of the same material as the piping.

No chemical vent shall interconnect with vents of other services.

Provide a pretreatment limestone neutralizing tank for the laboratory waste drain lines at the building exterior.

Details shall meet the requirements of the most restrictive local approving authority.

4.2.4 FOOD SERVICE ESTABLISHMENTS (FSE) WASTES

Cafeterias and kitchens shall comply with the most restrictive requirements of the local reviewing authorities for Fats/Oils/Grease (FOG) Discharge.

Provide garbage disposals in school kitchens.

Provide dishwashers in school kitchen. Use chemical rinse, no booster heater.

Grease interceptors shall comply with the Plumbing Code and the most restrictive requirements of the local reviewing authorities, and must be provided for all grease producing equipment. Inlet must terminate 12” below the liquid level. Capacity: 750 gal./min. minimum. This includes but is not necessarily limited to 3 compartment sinks, hand sinks and preparation sinks.

Manufacturers:

Grease Interceptors:	ProCast
Garbage Disposals:	Waste King, ISE
Dishwashers:	Hobart

4.2.5 OTHER SPECIAL WASTEWATER PROVISIONS

Other areas requiring special pretreatment of wastewater before discharge into the City sewer system include:

- Custodial Central Support Unit Hopper Sink: Solids interceptor.
- Auto Shop floor drains, sinks and cleaning tanks: oil Interceptor and clarifier.
- Auto Wash Rack: grease interceptor.
- Ceramics Room sinks: external solids interceptor (not under sink)
- Film Processing: neutralization, silver electrolytic recovery unit, sample box.
- Potting Room Sinks: solids interceptor.
- Agricultural Classroom Demo Table drains: Solids Interceptor
- Parking Garages: if hose bibs are provided, install drains to a sump and lift pump (if necessary) and oils and solids interceptors.

Interceptors and separators must be located and installed so they are easily accessible for inspection, cleaning, and removal of intercepted material without soiling or damaging their surroundings.

4.2.6 ROOF DRAINS

Roof drain pipes shall comply with requirements for sewer lines. (See also ADM Civil Engineering Section.)

Drains shall be recessed (or “bucketed”) type, with vandal-proof domes.

Manufacturers: Zurn, Smith

4.2.7 FLOOR DRAINS, AREA DRAINS AND FLOOR SINKS

Where drains or sinks are required, slope floor to drain at 1/8” per foot.

Floor drains with trap primers are required at:

- Student and staff restrooms. Locate under center urinal or lavatory, and near distant water closet in large restrooms.
- Shower and locker rooms and adjacent drying rooms.
- Eyewash / emergency showers.
- Mechanical and Electrical Rooms.
- Lunch shelters. Cast iron with removable basket and hinged self closing grate.

- Uncovered Trash Areas. These areas are required to be provided with a special floor drain system that normally drains the storm water to the storm system, but diverts the drainage to the sewer system when the trash containers are being washed, using a special valve system. See ADM Volume 2 – Section 2.2. 7 Civil Engineering - Storm and Sanitary Drainage.

Floor sinks with trap primers are required at:

- Boiler rooms.
- Kitchens, at cooking areas and where preparation sinks have an indirect waste drain rather than a direct connection.
- Coffee urns.
- Food preparation sinks (minimum 3").
- Milkshake machines.
- Refrigerators of 30 cubic foot capacity or over.
- Walk-in cooler and freezer box drains.
- Water heater relief valves and hot water storage tank drains. All water heaters shall be installed with drip pans.
- Wherever required by the California Plumbing Code or local authority codes.

Elevator pit drains are not required or desired.

Combination waste and vent systems shall be used only where structural conditions preclude installation of conventional systems and when permitted by the District.

- Use only with clear liquids and not on kitchen sinks, lunch shelter floor drains, or for any contaminated wastes.
- No water closet or urinal shall be installed on a combination waste and vent system.
- Provided adequate vents to ensure free circulation of air. Any horizontal branch more than 15'0" in length shall be separately vented.
- Waste and vent pipes shall be oversized to assure full venting.
- Vent connection shall be downstream of last fixture.

4.2.8 HVAC CONDENSATE DRAINS

Primary condensate drains from HVAC units shall be copper and discharged into a receptor in a manner that is approved by code and the local jurisdiction. Drain water from the HVAC unit condensate pans to a sewer system through a lavatory wye tailpiece or to a floor sink or custodial sink with an air gap. Do not drain directly into the sewer with air-gap fittings.

Secondary drain pans are required under all indoor HVAC units that are installed above finished ceilings or suspended exposed above occupied spaces. These drains should discharge at locations where the discharge will be noticed so that service personnel can be notified to fix the clogged primary drains. The point of discharge should be above a

sink if available, and if not, away from locations where it may cause harm to students and damage to books, electronic equipment and other contents of the space.

Provide di-electric unions at condensate drain pipe connections if steel meets copper.

The HVAC unit should provide high condensate level unit shut-off switches to prevent drainage from secondary pans, as well as freeze stats for DX equipment.

4.3 WATER SYSTEMS

4.3.1 WATER SERVICE

Coordinate with the Civil Engineer to define and request water service from the utility supplier. See also ADM Civil Engineering Section – Water Distribution.

4.3.2 DESIGN CRITERIA

Provide water service to all fixtures and outlets, designed in accordance with National Bureau of Standards Reports 66 and 79, with not less than 25 psi at farthest and highest fixture or the pressure required at the highest and farthest flushometer operated water closet to operate properly.

Allowable water velocity shall be 5 ft. per second for hot and 5 ft. per second for cold water in copper and nonmetallic piping.

Size pipe based on the number of fixture units and demand load curves in the California Plumbing Code.

Use Type L hard copper pipe inside buildings.

Use Type K copper or Schedule 80 PVC pipe underground.

Do not use under slab water piping. Where under slab piping is required obtain District approval.

Provide a shutoff valve to isolate all fixtures in each building, and in each toilet room, laboratory, cafeteria, kitchen and any other room with multiple fixtures. Valves shall be in recessed boxes with locking covers, located above the upper terminal water closet for restrooms and above fixtures in other areas.

Fixture supply lines: Provide angle stops for each faucet. Copper piping to each fixture, with brass nipples and chrome-plated brass escutcheons.

Run water lines to drinking fountains isolated from hot water lines to provide cool water at the fountains. Provide separate isolation valves at each fountain.

Provide thrust blocks and ties for bell and spigot water pipe at fittings for sizes 2 ½” and larger.

Slope pipes up in direction of water flow to air elimination devices, or up to a nearby expansion tank, to provide for air elimination from water lines.

Water hammer arrestors are required for lavatories, sinks, fountains, water closets, urinal headers, and other fixtures or devices with quick closing valves, such as clothes washers.

4.3.3 HOT WATER SYSTEMS

4.3.3.1 Hot Water or Tempered Water Locations

Provide hot water, in addition to cold water, or tempered water for the following areas:

- Administration and Health Offices -- Hot
- Cafeteria, Kitchen, Lunch Units, and Other Food Service Facilities -- Hot
- Faculty Workrooms and Prep Rooms – Hot
- Art Instruction Rooms, Consumer Home Economics, and Automotive Labs – Hot
- Custodial Room Service Sink – Hot
- Shower Rooms for Students – Tempered for students, plus one therapeutic station with hot and cold
- Shower Rooms for Faculty – Hot
- Handicapped-Accessible Showers – Tempered
- Restrooms Adjacent to Eating Facilities – Tempered
- Faculty Restrooms – Hot

4.3.3.2 Cold Water Only Locations

Provide cold water only to:

- Student Restrooms
- General Classrooms
- Kindergarten and EEC Rooms

4.3.3.3 Hot Water Temperature Regulation

To reduce the potential for bacterial contamination (see ASHRAE Standard 12-2000 – “Minimizing the Risk of Legionellosis Associated with Building Water Systems”) provide the following temperatures and control devices:

- General Hot Water Outlets: 120°F at the heater and 115°F at the furthest outlet from water heater.
- Tempered Water Outlets: 95° to 100°F mixed from 115°F to 120°F hot water from the storage tank and cold water through a tempered regulator valve. Locate the regulating valves as close to the outlet as possible. This is especially important for Special Education, Elementary Schools and Early Childhood Centers. Locate the valves in Custodian Rooms or similar rooms, not readily exposed in restrooms or shower rooms.
- Cafeteria Sink Outlets: 120°F.

Provide a circulating pump and insulated hot water circulation loop (supply and return) to the furthest fixture for:

- Faculty restrooms and nurse offices when they are farther than than 15 feet from the water heater.
- Runs longer than 50 feet for food service areas, custodial sinks, and other areas with high-flow faucets.
- Set aquastat to make at 100° F and break at 108° F.

4.3.3.4 Hot Water Heaters and Tanks

Water heaters shall be certified by the California Energy Commission and meet Title 24, AQMD Low Nox Rule 1121, and 1146.2. Comply with regional air quality management district rules for larger boilers.

Do not use multi-flue water heaters, boosters or instantaneous type water heaters.

Use 100-gallon, or smaller, high-recovery gas-fired domestic type water heaters. Use in series with manifold to limit the use of separate storage tanks. (Electric water heaters may be used as a last resort for isolated locations and in small sizes.)

Manufacturer: Rheem, Bradford-White, American, A.O. Smith.

Use hot water storage tank with external heater only where storage requirements exceed 200 gallons and where central plant capacity or other conditions indicate.

Provide ball valve with plug at water heater drain outlet.

Provide seismic anchorage for all equipment.

Provide drip pans at all water heaters and drain properly, except water heaters located in mechanical rooms on concrete floors with floor drains adjacent.

4.3.3.5 Hot Water Circulating Pumps

Circulating hot water pumps shall be time controlled so they will operate only when building is occupied.

Hot water circulating pumps over 1.5 hp shall have cast iron bodies. Pumps 1.5 hp and less shall have hard bronze water chambers and impellers.

Size hot water circulating pump and piping for water velocity not to exceed 5 feet per second.

Manufacturer: Bell and Gossett

4.3.3.6 Hot-Water Piping and Utilization

Provide tempered water to student showers, piped in series and connected with an insulated circulating supply manifold.

Provide isolation valves for each battery of showers.

Provide push-button metered type shower valves.

Reduction in lines connected to pumps shall be made as close as possible to the pumps.

Install straight length of pipe without bends or restrictions at least 10 diameters on the suction side of all pumps unless inlet diffusers are used.

Insulate supply lines and return lines when the length of run is over 15' to the furthest fixture.

Do not use check valves on cold water supply lines to heaters and hot water storage tanks.

Avoid running dead leg piping.

4.3.4 WATER VALVES AND OTHER DEVICES

4.3.4.1 Uninterrupted Service

Provide a minimum of two parallel branch lines for domestic water supply, a primary and secondary, to provide for uninterrupted service to the site during maintenance of a backflow preventer or a pressure regulating valve. Each branch shall have an above-ground valve station (in a secure enclosure) which includes a backflow preventer with strainer and when the street pressure exceeds 80 psig, a pressure regulator with strainer.

Provide a separate service for landscape irrigation, with an above-ground valve station that includes a backflow preventer and a pressure regulator with strainer when the street pressure exceeds manufacturer-suggested range, but never exceed 100 psi. Two parallel branch lines are not required.

Provide a separate service for fire protection.

Coordinate this design with the Civil Engineering, Fire Protection, and Planting and Irrigation sections of the ADM.

4.3.4.2 Pressure Regulating Valves

Install pressure regulating valves with strainers when street line pressure is over 80 psig to reduce pressure to approximately 80 psig.

Pressure regulating valve (PRV) stations shall include a minimum of two District approved pilot/diaphragm actuated control valves with strainers in lieu of a series of 2" direct acting regulators. Valves shall be flanged and sized to provide uninterrupted service to school site when valves are being serviced. Wafer lug type butterfly valves and preassembled valve stations may be used to minimize space needs. (Services over 6" may require a third, smaller PRV for constant low flow demands.)

Provide removable gauges with ball valves for isolation stops on both inlet and outlet.

Provide an epoxy coated wye strainer ahead of regulators.

Locate pressure regulating assemblies and strainer assemblies above grade in a shielded enclosure and in a service area. Where exposed to students, enclosure shall be a secure structure or cage.

4.3.4.3 Backflow Preventers

Use backflow prevention valves having very low friction loss.

Use reduced-pressure backflow assemblies for domestic and irrigation services for service 2" and larger.

Provide an epoxy coated wye strainer ahead of valves.

Provide appropriate backflow preventers where required by Code for Fire Services.

Manufacturer: Wilkins

4.3.4.4 Vacuum Breakers

Vacuum breakers or other required backflow prevention valves are required for (although not limited to) the following locations:

- All flush valves and urinals.
- Direct connections to boilers and tanks.
- Water-cooled refrigerator condensers.
- Soft drink dispensers.
- Hose bibs and sill cocks.
- Demonstration tables.
- All laboratory equipment.
- Dark room equipment.
- Blueprint equipment.
- Silver soak sinks.
- Garbage can washers.
- Most types of animal drinking water devices.
- Various types of processing equipment.
- Cooling towers and evaporative coolers (or provide air gap).
- Sewage pumps.
- Fire sprinkler systems.
- Irrigation systems.

4.3.4.5 Hose Bibs and Sill Cocks (Loose key)

Provide loose key sill cocks under exterior drinking fountains with isolation valves. Sill cocks are faucets with a hose connection installed approximately at the sill line of buildings.

Provide loose key hose bibs or sill cocks at approximately 75'-0" spacing around buildings, and within 25’of entrances with walk off mats. Install in recessed boxes with locked covers. Coordinate desired locations with Custodial Services and Landscape Architect.

Provide sill cocks with isolation valves in shower and locker rooms so that a 50'-0" long hose can be used to wash down entire area.

Hose bibs are not recommended in kitchens or other interior areas except as noted above.

Provide loose key hose bibs or sill cocks, with isolation valves, at outside eating areas, in boiler rooms, on rooftops with skylights or air cooling equipment for wash down of equipment and pads, and on rooftops for wash down of bird droppings and debris on ladders and façade projections.

Manufacturer: Chicago, Zurn

4.3.4.6 Isolation and Shut-Off Valves

All shut-off valves shall be accessible from the room in which fixtures are installed, and shall be located at approximately 3'0" but not more than 7'0" from the floor. These valves shall control only fixtures in the room in which they are installed.

Provide shutoff valves for each group of fixtures, science laboratory or preparation room, toilet room, building, located at the entering point of building with yard box

Provide a remote control solenoid shutoff valve for gang shower tempered water; located down stream of manual shutoff valve. Locate remote control at coach's office.

Use gate or ball valves for plumbing isolation shutoff.

4.3.4.7 Emergency Shower and Eye Wash

Emergency shower and eye wash equipment shall be installed in the following areas when eye or skin irritants exist and must comply with California Code of Regulations (CCR), Title 8, and Section 5162:

- Chemistry classrooms and teachers' chemistry work rooms
- Pool mechanical equipment rooms
- Custodial storage areas

Provide a counter-mounted emergency eye-wash at the disabled-person workstation (with floor drain in front).

Drench hose shall be installed in the Teachers' Chemistry Workroom, but only as a supplement to an approved Emergency Shower and Eyewash in the classroom, as stated in Title 8 Section 5162.

Provide floor drains with trap primers at emergency fixtures.

Manufacturer: Haws or Bradley.

4.3.5 DRINKING FOUNTAINS

Drinking fountains are required by the California Plumbing Code on every floor, as well as in other specific locations.

Install fountains in locations and above floor surfaces, where water falling from the fountain on to the floor does not cause a slipping hazard. (See ADM Volume 1 - Section 1.2.6 School Building Functional Spaces – Restrooms and Drinking Fountains for specific location and planning requirements.)

Manufacturer: Haws Series 1501, Wall-Mounted, Hi-Lo, Cast Iron (or approved equal)

Haws Series 3500 “Street Smart,” Hi-Lo, Coated Stainless Steel, with Haws 6635 sand traps (No Exceptions)

4.4 GAS DISTRIBUTION SYSTEMS

General gas service at elementary school systems are low pressure (8" of water column), and secondary school systems are medium pressure (3 psi at the meter and 1 psi maximum drop to most remote outlet). Medium pressure systems are allowable for site gas distribution for elementary schools with multiple buildings when the gas company permits. A properly vented pressure regulator and an approved accessible gas shutoff must be provided. If required by code, statute or regulation, provide an approved accessible gas shut off at each building.

4.4.1 GAS METER LOCATIONS

Locate meters where a straight service run from the street can be made by the gas company.

Locate meters where it is accessible by truck for service and replacement.

Locate meters as central as possible to the major gas loads (main boiler rooms, relocatable classrooms groups, etc.) to minimize size and length of main pipe runs.

Meter locations must be approved by the District and the gas company.

Meter enclosure must be secure and vandal resistant, and should have asphalt or gravel flooring (not concrete) with meter, valves and PRV above grade.

Use of medium pressure gas requires design with “polyflo calculator” for gas company approval.

Provide on plans a gas load schedule for each meter including existing, new and future load in cfh.

4.4.2 GAS PIPING

In buildings or above ground at least 6” or as approved by the District: steel.

Underground (30” minimum cover): Polyethylene, fusion welded, embedded in 6” of sand all around.

Include tracer wire, yellow insulated 18 AWG.

Connect to steel pipe with Central Plastics Company prefabricated transition fitting or equivalent.

4.4.3 GAS LINE LOCATIONS

Locate pipelines above grade within the building and underground to each building whenever possible.

Locate pipelines through attic spaces, within covered walkways, and in ventilated crawl spaces.

Avoid lengthy horizontal rooftop mounted piping wherever possible.

Avoid running gas lines through one building to serve another.

In isolated cases such as kitchens and science rooms where gas branch lines must penetrate a concrete slab, run pipes in a concrete trench with steel checkered plate cover and frame.

Provide a gas service stop in an accessible location outside each building at the point where a gas line enters the building.

For permanent buildings, locate gas lines on the riser with swing joint at point of entry.

For portable buildings, locate gas lines in yard boxes.

Provide only one gas line entry per building unless unusual circumstances exist.

4.4.4 GAS VALVES

Provide an accessible shut-off valve for each gas outlet or group of outlets within a room.

Use an approved gas cock when valve is readily accessible.

An approved ball valve may be used when it is not accessible to students.

Provide individual check valves for gas outlets or turrets adjacent to air or water outlets, such as for laboratory stations.

Provide a master shut-off valve for science labs in a secure area not accessible by students.

Provide a solenoid operated, fast operating, safety shut-off valve with control readily accessible from the teacher demonstration station for all gas outlets in a science laboratory or a preparation room, similar to those used for individual lab stations noted above.

Provide an isolation valve for each floor in each building.

Provide isolation valves at each regulator.

Provide DSA approved seismic automatic gas shut-off valve at the meter and if required by code, statute or regulation, at each building, resettable by maintenance personnel.

Provide a shut-off valve on each gas line entering a building at outside point of entry into the building.

All shut-off valves must be secured from student or public tampering.

4.5 COMPRESSED AIR SYSTEMS

Provide air compressors as follows:

- Shop Areas: 3 HP minimum.

- Senior High Shops with Car Hoists: 7 ½ to 10 HP. (Two or more car hoists require at least a 5 HP compressor).
- Other areas requiring air: 1 ½ HP.

Air pressure:

- Hose connection for paint spray gun: 20 psi.
- Other locations: 124 to 175 psi.

Manufacturer: Ingersoll Rand Compressor

4.5.1 PAINT SPRAY FACILITIES

Provide an electrically controlled valve in the air line to paint spray booths so that no air is supplied to the spray gun when door is open.

Spray guns, pressure reducing valves, gauges, strainers, hose and hose racks are furnished by the District.

4.5.2 CATHODIC PROTECTION

For sites where cathodic protection is indicated, use nonmetallic piping, unless unusual conditions and District directions indicate otherwise.

Check to ascertain if cathodic protection is in use when designing for existing sites.

4.5.3 SEISMIC RESTRAINT

Provide seismic restraints for mechanical equipment and piping systems in accordance with applicable codes and guidelines.

4.5.3.1 Liquid Filled Steel Pipe

Follow SMACNA "Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping" latest edition.

5. FIRE PROTECTION

5.1 GENERAL REQUIREMENTS

This section contains local fire authority criteria and information on its review procedures, fire sprinkler systems, fire extinguishers, and related fire and life safety requirements. Other criteria and guidelines include applicable portions of the California Fire Code and NFPA Standards.

See ADM Civil Engineering and Plumbing Sections for additional information.

Fire hydrants: 6” inlet with one 4” and two 2 1/2” outlets (unless otherwise required by local fire authority).

Manufacturer: Fire Dept. Connection: Orvin, Grinnell

5.2 LOCAL FIRE AUTHORITY REVIEW

The Division of the State Architect (DSA) requires that local fire jurisdictions review and approve all new construction projects prior to DSA final approval. Local approval includes:

- Access from the public street to each new building within the site (CCR Title 19 - Section 3.05 Access Roads).
- Perimeter fencing and gated entrances (CCR Title 19 - Section 3.16 Gate Entrances to School Grounds).
- Fire hydrants, if required.
- Standpipe locations.
- Emergency Assembly Area (EAA) and Evacuation Plan.

For local review, provide a full site plan indicating all buildings, both existing and proposed, fences, drive gates, retaining walls, EAA, and other construction affecting fire department access. Indicate approved unobstructed fire lanes for access to buildings on the site plan.

The local fire department must signify approval on drawings and sign a standard approval form furnished by DSA.

Local fire prevention agencies for SBCUSD schools are:

San Bernardino City Fire Department (Within City of San Bernardino)
Fire Prevention Bureau, Douglas Dupree, Fire Marshal
PHONE:909-384-5388

San Bernardino County Fire Department (Within S.B. County areas)
Office of the Fire Marshal, Chief Pat Dennen
PHONE: 909-386-8400

California Department of Forestry (Within City of Highland)
Fire Prevention , Capt. Debbie Chapman
PHONE: 909-864-6861, X248

5.3 FIRE SPRINKLER SYSTEMS

Provide an automatic fire extinguishing system whenever required by code in every new school building in accordance with the current California Building Code - California Code of Regulations, Title 24, NFPA 72, and requirements of the Division of the State Architect. However, use building and area separation walls to avoid the requirement for sprinklers wherever possible. Evaluate initial cost and additional grant funds to be received for sprinkler system(s) verses initial construction cost of building(s) without sprinkler systems prior to commencing conceptual or schematic design.(It may be more cost effective on a project cost/grant basis to construct a multistory sprinkled one building campus then several small buildings and related utilities and site work without sprinklers due to multistory and sprinkler grant incentives.)

The fire sprinkler system must be interconnected with the school fire alarm system.

On fire mains, provide double detector check assemblies before the fire department connection.

Manufacturer: Fire Detector Check Assembly: Wilkins

Fire sprinkler systems with 100 heads or more are required to have 24 hour monitoring by an approved central monitoring station.

If a fire pump is required, include all hydraulic calculations on drawings.

5.4 STANDPIPES

Fully sprinkled buildings do not require Class II standpipes or fire hose cabinets.

Stages over 1,000 square feet must have Class III standpipes, even in fully sprinkled buildings.

Class I dry standpipes are required for buildings 4 stories or more.

Dry standpipe outlets shall be unobstructed and readily accessible to the Fire Department, and all connections shall conform to Code and fire authority requirements.

Confirm with local fire department having jurisdiction the requirements for Knox boxes at fire lane site access gates and/or building entrances. If required provide boxes at 8’ to 10’ above grade.

5.5 FIRE EXTINGUISHERS

Portable fire extinguishers, UL lockable cabinets, accessories and notification signs shall be specified as part of the contract for construction. They shall meet minimum requirements for acceptance by the State Fire Marshal and local fire authority.

All areas of all buildings must have portable fire extinguishers within 75’ of any point. Provide fire extinguishers in accordance with CCR Title 19.

Locate extinguishers within an occupied room in a conspicuous place. A sign labeled "Fire Extinguisher Inside" shall be applied to interior and exterior faces of the door.

Extinguishers shall not be located on exterior of buildings, in corridors, stairs, or other unsupervised areas.

Fire Extinguisher Monitoring System: Unless otherwise approved in writing in advance by the District, for each extinguisher, provide an automatic monitoring system that monitors pressure, presence, and obstructions, and communicates the information from the fire extinguisher to the school's fire or security control panel through a sensor interface module (either wired or wireless).

Manufacturer:

General: Ansul Sentry Stored Pressure, Dry Chemical, UL Rating 3-A : 10-B : C, 5 lb., Red-painted Steel.

Kitchen: Ansul K-Guard Kitchen Class, Liquid Agent, UL 2-A : 1-B : C : K, Class K (Combustible Cooking Media), 1.6 gal.min., Stainless Steel (2 per kitchen).

Monitoring System: en-Gauge System from MIJA, Inc.(Pressure Gauge Mfctr.)

Fire Extinguisher Cabinet: Ansul, JL Industries, Potter Roehmer, Larsen's Mfg.

Paint Booth System: Pyro-Chem PCI 50 with Fire Links 165° F

5.6 KITCHEN FIRE SUPPRESSION SYSTEM

In kitchen provide hood-mounted automatic fire-suppression system covering all appliances beneath the hood and automatically shutting off appliances. Provide remote manual pull station.

Manufacturer:

Ansul R-102 Liquid-Agent System with automatic detection and actuation, electrical switches for automatic equipment and gas-line shut-off, overlapping nozzles to cover the group of appliances, UL 300 rated

6. HVAC SYSTEMS

6.1 GENERAL REQUIREMENTS

All interior spaces shall be air conditioned unless specifically excluded in this Architect Design Manual (ADM), or in writing by the District. Spaces that require only ventilation, not cooling, are mechanical equipment rooms and power transformer rooms.

Regulations and Standards (current) applicable to HVAC (Heating, Ventilation, Air Conditioning) Systems design include:

- California Code of Regulations, Title 24;
- ASHRAE(American Society of Heating, Refrigerating and Air Conditioning Engineers);
- SMACNA (Sheet Metal and Air Conditioning Contractors National Association);
- NFPA(National Fire Protection Association);
- Local authorities having jurisdiction.

Provide separate HVAC units for MDF, IDF and other computer spaces – preferably roof mounted.

Performance of the HVAC system, in conjunction with the envelope and lighting design, shall exceed the energy efficiency requirements of Title 24, latest edition, by **20%** or more**.** Refer to CHPS publications and scorecard for latest requirements.

Submit applications and calculations to **DSA** to take full advantage of California State incentives for higher energy efficiency.

Submit applications and calculations to utility suppliers to take full advantage of incentives for higher energy efficiency, including **"Savings by Design."**

Refer to ADM section on **"School Environment and Sustainability"** for additional requirements on energy and commissioning.

Locate all primary equipment, wherever practical, on the roof or in mechanical rooms within the building.

Accessibility for service of equipment is critically important. Provide adequate access to and working area around equipment for service or replacement. Demonstrate work areas and access paths in the Design Development phase.

Provide hose bibs on roof top in locations necessary to clean and service HVAC equipment with a 25-ft. hose.

Provide factory-installed convenience outlets on HVAC units for servicing.

Install all HVAC units on vibration-isolation curbs.

Packaged rooftop units shall be downward discharge.

Packaged rooftop units shall have heavy-duty vandal-resistant coil guards (confer with District for standard detail).

Assure that structural support and seismic anchorage of all equipment is adequate both to support loads and to minimize deflection and reduce vibration.

Provide 5 year parts and labor warranty on HVAC units, chillers and package units. Architect to CONFIRM THAT THIS IS AVAILABLE AND AFFORDABLE. Provide quote for upcharge, if any., to District for final determination prior to including requirement in design,

Efficiencies:

- HVAC Units: 14.0 SEER and 12.0 EER minimum
- Heaters: Gas efficiency rating of 80% AFUE minimum.

Manufacturers (General Preferences):

- HVAC Package Units: Carrier Corp.
- Boilers for space heating and swimming pools: Bryan
- Air Compressors: Ingersoll Rand
- Air Dryers: Ingersoll Rand
- Circulating Pumps: Bell & Gossett
- Expansion Tanks: Therm X
- Vacuum Pumps: Ingersoll Rand

Specify the work of this section in Division **23 00 00, Heating, Ventilating, and Air Conditioning,** and Division **25, Integrated Automation,** in accordance with CSI Masterformat 2004 Edition.

6.2 SYSTEM SELECTION AND DESIGN CRITERIA

6.2.1 HEATING AND COOLING LOAD CALCULATIONS

Indoor and outdoor design conditions and other relevant data shall be in accordance with current ASHRAE publications.

Provisions for internal heat gain from occupants and equipment within a space shall be in accordance with the Facilities Program information.

Provide calculations for equipment and system selection to show compliance with criteria, including fan and pump selection curves, heating and cooling coil selection data, chiller and cooling tower selection data, duct friction and pipe friction loss calculations, etc.

When requested by the District, provide calculations to justify system or equipment selection choices, such as life-cycle cost and energy analysis,

Perform calculations on an industry recognized computer program such as Energy Pro, Trace 700, or HAP, that will demonstrate compliance with Title 24. Calculations shall be done for each system for each room and for each building.

The California Energy Commission (CEC) Certificate of Compliance for Nonresidential Buildings with the necessary backup forms shall be completed for submittal to the Division of the State Architect (DSA) and review by the District. Title 24 Compliance calculations shall be performed on the performance basis using the whole building approach, and integrating the building envelope, mechanical and electrical systems as designed, on a CEC approved program such as Energy Pro or Perform.

For existing facilities modernization or replacement projects, conduct a field survey of actual conditions and assessment of current demand, and provide an Existing Condition Assessment Report for District review and approval.

6.2.2 VENTILATION AND OUTSIDE AIR CALCULATIONS

Provide outside air to each room through the HVAC system in compliance with current CBC and CEC Standards and ASHRAE recommendations.

Clearly indicate how outside air is provided and how much for each HVAC unit. Also, indicate with pressure calculations how air is relieved from the building, on regular cycle and economizer cycle, to balance the fresh outside air makeup and relief, and to maintain building pressures to assure compliance with CBC door closer settings for accessibility. COORDINATE WITH ARCHITECT TO ASSURE THAT REQUIRED OPENINGS ARE PROVIDED.

Do not use power exhaust for classrooms or other small unitary systems, both to reduce cost and to minimize noise levels.

6.2.3 AIR FILTRATION AND PURIFICATION

Provide air filters with a minimum efficiency of MERV 8. For new schools constructed in areas with low outdoor air quality, such as those close to freeways, provide air filters having a minimum efficiency of MERV11.

ALTERNATE: Provide MERV 11 (or greater) filters for all HVAC air handlers (CHPS Credit EQ2.5).

Provide ultraviolet germicidal lamps to prevent mold and bacterial growth on cooling coils.

Provide ultraviolet germicidal lamps for air-stream purification in air-handling units for all normally occupied spaces.

Manufacturer: Spira-Aire (Coils)
Airabella (Air Stream)

6.2.4 SYSTEM SELECTION CONSIDERATIONS

Following are considerations – by no means all – that must be considered in selection of HVAC systems:

- Building size, type and number of stories.
- Orientation and window shading.
- Roof type: Flat vs. pitched.

- Single building projects vs. Multiple building projects.
- Building new plant vs. Building on an existing school site or in an existing building.
- Energy efficiency.
- Variable or flexible operating schedules.
- Ease and practicality of installation.
- Ease and simplicity of operation and maintenance.
- Proven reliability of system and materials.
- Acceptable procurement leads time.
- Acoustical qualities.
- Susceptibility to vandalism.
- Degree of disruption of occupants during modernization.
- Initial capital cost.
- Operating and Maintenance cost.
- Life cycle cost:

When highly energy efficient or innovative installations that incur a higher initial cost are proposed, they must be justified to the District with **life-cycle cost analysis**, calculated as follows:

- The life cycle cost calculations shall be performed on an industrial standard program such as Trace 700 or DOE-2. The calculations complete with all input and supporting data shall be submitted to the District for review.
- The life cycle cost shall consider the incremental cost of building enclosure, structure, electrical service and other utilities as well as the HVAC system.
- Cost estimates, initial and replacement, shall be made in an industry recognized format and using manufacturer cost data or data from a nationally recognized source such as Saylor or Means.
- Utility costs shall be obtained from the utility providers and shall include historical cost escalation trends.
- Maintenance cost shall include a breakdown of labor and materials for each piece of equipment or system component based on nationally recognized references.

6.2.5 SELECTION REPORT

Submit a **"Basis of Design"** narrative that includes a system selection report that addresses all the relevant considerations, based on the guidelines of Chapter 1, HVAC System Analysis and Selection, of the latest edition of the ASHRAE Handbook,

6.3 OVERVIEW OF HVAC SYSTEMS

The following narrative addresses decentralized, centralized, and hybrid systems and equipment, with discussion of their advantages and disadvantages, as a general background to system selection.

6.3.1 DECENTRALIZED SYSTEMS

Decentralized systems are systems where the primary source of cooling, heating or supply air is provided from independent sources distributed throughout a building or a campus. Typical decentralized systems consist of the following:

6.3.1.1 Small Single-Zone Unitary Systems

Single-package constant-volume rooftop air conditioning units with gas heating, packaged rooftop heat pumps, split-system air conditioning units, split-system heat pumps, and wall mounted heat pumps or air conditioning units -- all of less than 25 ton capacity normally fall under the category of small single-zone type unitary systems. Most are less than 10 tons.

Small single-zone unitary systems are usually controlled by a single dedicated thermostat, but means of providing multiple-zone controls for such unitary systems are available, such as variable volume and temperature (VVT) controls systems. Such systems are categorized under small single-zone unitary systems because they can not heat and cool simultaneously.

When single-zone unitary systems are provided for classrooms, one dedicated unit shall be provided for each classroom. Units shall be for vertical (downward) supply and return.

For classrooms, positive means for fresh air makeup must be provided (note especially split systems). Sufficient means to relieve exhaust air (for both regular and economizer cycles) must also be provided, in order to maintain door opening and closing pressures that comply with CBC accessibility requirements.

Variable volume and temperature (VVT) controls can sometimes be used for administrative and support areas, to serve rooms of different size and occupancy. They should not be used for classrooms because, at low heating or cooling demands, it is hard to maintain minimum ventilation levels. With VVT controls, rooms of dissimilar thermal profiles, such as interior and exterior zones, north and south exposures, or other significant load conditions, must not be served by a common unit.

Window or wall mounted units should not be used for classrooms. They not only take up otherwise usable space, but they generate high noise levels that interfere with instruction. Teachers shut them off, but then the required ventilation is not achieved and students will get drowsy. (Some newer units have multiple levels of cooling that permit operation at lower sound levels while still maintaining adequate ventilation; they should only be considered for retrofits or portable classrooms.)

Selected Preferences:

∞ Rooftop package units are preferred over split systems, even for multi-story buildings.

- Gas heating is preferred over heating provided by air-cooled heat pumps.
- Electric: 480 volt, 3 phases, with 120 volt convenience outlet factory installed on unit, for service use.
- Power, control, condensate and gas lines inside mounting curb (see also section on "Equipment Mounting and Isolation").
- Package units shall be fully factory assembled, including economizers, with 5-year parts and labor warranty.
- Heat pumps should not be used where 24-hour operation is required or where the ASHRAE Bin weather data indicates heating design temperatures below 40 degrees for more than an hour at a time during the normal hours of school operation.

Manufacturer: Package Roof Top Units: Carrier." Centurion."

6.3.1.2 Multi-Zone Unitary Systems -

Roof-mounted, self-contained triple-deck multiple-zone air conditioning units are categorized as multi-zone type unitary systems.

Today, these systems are normally provided only as replacements.

6.3.2 CENTRALIZED SYSTEMS

Centralized systems are systems where the primary source of cooling and heating is provided from a central source for a building or a campus. Centralized systems may consist of the following:

6.3.2.1 Central Chilled Water Plants

Central chilled water plants may be air cooled or water cooled.

Water-cooled systems are preferred over air-cooled systems due to higher energy efficiency.

Air cooled systems should only be used only where practical limitations exist for a cooling tower.

Evaporative condensers should not be used due to the tendency to lose efficiency rapidly from scale formation on the wetted tubes from hard water.

A minimum of two independent chillers, working on lead lag, with associated accessories shall be provided for a campus-wide central chilled water system for redundancy.

Campus-wide central chilled water systems shall be designed as variable-flow constant-temperature systems for energy savings and dehumidification effectiveness.

The location of the central plant shall not be so remote that the energy savings of the water-cooled chiller system is offset by the additional energy consumption of the chilled-water pumps.

Cooling towers shall be located away from HVAC outdoor air intakes, openings into buildings and areas normally occupied by students to reduce the possibility of Legionnaire Disease.

The air-delivery energy consumption can also offset the energy savings of the water-cooled chiller system. Air-delivery energy is usually the largest energy consumption component of the building air conditioning system. Design the air-delivery systems to limit energy consumption from excessive duct friction. Analyze the feasibility of using low temperature supply air systems to reduce energy consumption.

Do not use variable-air-volume systems for classrooms without providing a means for ensuring that each classroom is adequately ventilated and that indoor air quality is maintained -- for example, by use of carbon dioxide monitors that are interfaced with air-handling unit controls to modulate the outdoor air-intake dampers. Variable-air-volume boxes should be located outside the classroom area to reduce noise.

6.3.2.2 Central Boiler Plants - Hot Water or Steam Heating

Hot water boilers are preferred over steam boilers. Steam boilers are normally provided only for replacements.

A minimum of two independent boilers and associated accessories shall be provided for a campus-wide central hot water system, for redundancy.

6.3.3 HYBRID SYSTEMS

Hybrid systems are those where a common water loop for heating, condensing or heat exchange is provided from a central source for a building or a campus whereas primary cold or heat generators may be distributed. Hybrid systems may consist of the following:

6.3.3.1 Water Source Heat Pumps

Follow guidelines regarding location of cooling towers.

A minimum of two (for redundancy) independent cooling towers, two boilers and associated accessories shall be provided for a campus-wide central condenser water system.

6.3.3.2 Geothermal Heat Pumps

If geothermal sources are available, provide analysis for justification. Obtain approval from the District before using geothermal heat pumps. Contact City of San Bernardino for information regarding the extent and reliability of their geothermal loop system downtown.

6.3.3.3 Variable-Air-Volume Units

In general, large packaged roof-top variable-air-volume (VAV) units with heating hot water from a central boiler plant should be limited to administrative or support areas and preferably not used for classrooms. Review the need for VAV air distribution to classrooms with the District before proceeding with design.

6.3.4 UNITARY VS. CENTRAL SYSTEMS COMPARISON

Although central systems frequently offer many advantages over unitary systems, when all factors have been weighed and evaluated, unitary systems are usually chosen for schools because of their lower initial cost, ease of maintenance and their simplicity.

6.3.4.1 Advantages of a Central System

Central system equipment often has more technical advantages and capabilities over unitary systems. The total installed cooling or heating capacity of a central plant is normally less than that of unitary equipment. Other advantages:

- Higher operating efficiency than unitary equipment.
- Longer life.
- Better temperature control.
- Lower noise levels.
- Better indoor air quality due to greater air filtration flexibility.

6.3.4.2 Disadvantages of a Central System

The cooling (refrigeration) energy of a central plant is usually more efficient than in distributed systems. However, the air-moving energy is usually twice that of the cooling energy in a typical school building. Central systems are sometimes less efficient than unitary systems because the air distribution systems are not designed to be energy efficient.

The energy consumption and cost of operating a cooling tower, chiller and associated pumps to service a few periods of after-hour or holiday operation of a few classrooms could offset the annual energy and cost savings of the entire system.

Entire system could be affected by the failure of one component. Large areas might be shut down due to the failure of one large air-handling unit. The failure of one chiller or boiler could reduce the cooling and heating capacity by half. Other disadvantages:

- High initial cost.
- Larger space requirements.
- Multiple responsibilities for installation.
- Need for more highly skilled maintenance and repair personnel.
- Long lead times for obtaining equipment and replacement parts.
- After-hour or off-schedule operation is not usually convenient or efficient.

For modernization or expansion of existing school plants, the addition of central systems is rarely cost effective. And, in modernization projects, carefully chosen and designed unitary systems can be installed with minimum disruption to the ongoing educational process.

6.4 CONTROLS AND ZONING

6.4.1 GENERAL

Air conditioning systems shall have a fully automated, integrated and programmable Direct Digital Control System (DDC) for school-wide energy control and management functions. System shall be IP and Web-based so monitoring and control can be done over any network-connected computer in the District's Wide Area Network. Operator interface shall include site and building floor plans to show all controlled devices.

Control devices shall be factory-installed on equipment components, ready for interconnections to remote sensors and to the site network via the equipment manufacturer's proprietary network cabling and devices.

Beyond the interconnected control wiring within each wing or building, the control system shall interconnect within each Telecommunications Room with the site LAN and its structured cabling system. It shall then use the fiber-optic backbone cabling, with Ethernet and IT protocols, to communicate with the main LAN Room and then interconnect with the District Wide Area Network for central monitoring and control at the M&O Headquarters, as well as from any device over the Internet.

The intent of these design criteria is to provide for an integrated communication and control system that communicates over the site LAN and its structured cabling system, utilizing the fiber-optic backbone for all between-building cabling, and provides integrating functionality with the District's major control systems for existing schools. It shall have the capability to integrate the functions of other vendors' building management systems, such as lighting controls.

Interconnection with safety and security systems shall be provided.

The manufacturer's representative shall oversee the installation of the complete system. Control system and equipment, including control sequences and provisions for future, shall be fully presented in the contract documents and specified in **Division 25, Integrated Automation (CSI Master Format 2004)**.

The DDC systems shall be:

Manufacturer: **Carrier Corp."Comfort Network**" or approved equal, including "Precision Link" for packaged units, and Ethernet converters and CCN Web where appropriate.

US Air Conditioning Distributors or approved equal
City of Industry, 626-854-4692
Mario Orozco, 626-622-4692
www.us-ac.com, m.orozco@us-ac.com

6.4.2 TEMPERATURE CONTROL & THERMOSTATS

Provide an automatic system of temperature control for all systems.

Each unitary HVAC unit shall be provided with a factory preprogrammed school-type digital thermostat with a manual push-to-start switch. This switch shall also stop the unit when held for 30 seconds. The program shall enable the units to stay on after being

started, on school days, until the end of the school day, unless they are manually turned off (to open operable windows, vacating the room, or other reasons). For after-hours or off-schedule operation, the unit shall stay on for a preprogrammed duration after being manually started. Review this thermostatic control requirement with the District for each specific project.

Each classroom shall be a separate air-conditioned zone.

Small rooms such as adjacent offices on the same exposure, a small shared work space, and other small spaces of similar thermal profile may be combined into one control zone.

A common air handling system shall not serve areas that are not on similar operating schedules.

Thermostats shall be located at the most representative space temperature location.

Thermostats shall not be located in areas that are accessible to unsupervised students, such as hallways, corridors and lobbies.

Thermostats in gymnasiums shall be protected from possible damage by the impact of balls, etc. or they should be remotely located with temperature sensors in the conditioned space or return air ducts.

All thermostats shall be provided with lockable vandal resistant covers, digital readout and bypass or field adjustment.

Do not use wireless controls.

For modernization or equipment replacement projects, replace any existing pneumatic control systems with direct digital controls.

6.5 AIR DISTRIBUTION

6.5.1 VENTILATION AND OUTSIDE AIR

Provide outside air to each room through the HVAC system in compliance with current CBC and CEC standards and ASHRAE recommendations.

Clearly indicate outside air provisions and flow rates for each HVAC unit, and relief provisions to balance the fresh outside air makeup and to relieve exhaust air in all operating cycles.

6.5.2 FRESH AIR INTAKES

Locate fresh air intakes to prevent contamination from kitchen exhaust, garage exhaust, or any process exhausts by locating the intakes on the upstream (prevailing wind) side of exhaust openings, as far away as possible.

Limit intake velocity to 750 FPM through net free louver area at 100% fresh air quantities to keep noise, pressure drop and rain carryover to a minimum.

Install a floor drain at the fresh air intake into larger air-handling unit rooms.

6.5.3 DUCTS

Comply with current code and SMACNA Guidelines for duct construction. For exposed ductwork and other special conditions, use thicker metal gauges for ducts and hanger straps

Ducts: 24-gauge rectangular, 26-gauge round, minimum. Galvanized.

Do not use fiber duct.

Size ductwork (supply, return and exhaust) on equal friction method based on 0.08" wc per 100' with a high velocity limit of 1,000 fpm above occupied areas (850 fpm for unitary equipment above classrooms) and 1,500 fpm inside shafts, unless directed otherwise by the project acoustical consultant.

Return air shall be in ducts, not a ceiling plenum, in order to improve indoor air quality.

Allowable air velocities for ducts above acoustically sensitive areas shall be determined by an acoustical consultant retained by Architect as part of Basic Services..

Changes in size at every branch or every interval are not warranted economically unless branch represents a substantial percentage.

Sound attenuators or lined ducts should be installed on inlet and outlet side of fans and between fans and ducts to prevent fan noise entering rooms through the duct system. Do not locate sound attenuators in ducts above the ceiling of classrooms or similarly occupied spaces, where breakout noise will increase indoor noise levels.

Fire dampers or combination smoke and fire dampers must be installed in all ductwork as required by all applicable codes and the State Fire Marshal and clearly on the HVAC floor plans.

Coordinate with the project electrical engineer to take advantage of total coverage smoke detection systems and save the duplicate cost of installing smoke detectors separately for the HVAC system.

6.5.4 AIR INLETS AND OUTLETS

Select and lay out supply air outlets and exhaust and return air inlets in accordance with current ASHRAE guidelines and project acoustical requirements.

6.5.5 FANS

Select fans to minimize noise and to meet noise level criteria in occupied spaces.

Direct-drive fans are preferred over belt-drive for smaller exhaust fans of the centrifugal roof exhauster, ceiling, inline or cabinet type.

Exhaust fans for special conditions, such as kitchen hoods, fume hoods, kiln hoods, spray booths; dust and sawdust collection systems require special attention to construction details, explosion hazards, noise and location.

- Roof fans handling exhaust from kitchen hoods require a shaft seal and a special insulated plate to separate fan from motor compartment.

- Fans exhausting fume hoods require spark resistant construction, and special coatings to prevent chemical action on fan and housing. The motor shall be explosion-proof and located outside of the air stream.
- Fans exhausting paint spray booths require spark resistant construction. The motor shall be explosion-proof and located outside of the air stream.
- Fans exhausting kiln hoods require force-vented motor compartment and special construction to withstand high temperature.
- Prefabricated dust-collection systems shall be used for removal of saw dust in wood shops.

6.5.6 OUTSIDE-AIR ECONOMIZERS

The California Energy Commission prescribes 100% outside-air economizers for equipment with supply air capacities over 2,500 cfm or 6.25 tons cooling capacity. That is the usual low limit for satisfactory payback at locations where weather conditions are least conducive to 100% outdoor air economizer operation with fan assisted relief.

For units of 7 ½ tons capacity and higher, which are usually used for administrative areas, multipurpose rooms and gymnasiums, outside air economizers with power exhaust systems are recommended.

Economizers should not be used when the outdoor air quality is low or when the outdoor ambient sound level is high, as for schools close to a freeway. They should not be used with small split systems. They may be omitted when the District's energy efficiency requirement can be met with other measures and when the inclusion of large gravity relief openings in the wall imposes architectural design difficulties. Review with the District.

For classroom small unitary systems (3, 4 & 5 ton capacities), 100% outdoor air economizers are also recommended to achieve energy savings and to more easily comply with CHPS Energy Prerequisite and Credits. This enables more effective flushing out the building prior to occupancy, night-time purging, as well as seasonal energy conservation.

These economizers, however, are to be used with gravity relief of exhaust air, not with power exhaust systems. Power exhaust is not recommended for small unitary systems for several reasons.

- The maximum cost of a typical 4-ton rooftop gas-electric HVAC unit is about $4,000 (plus installation). The cost of a power exhaust accessory for these units is about $4,000. This is a substantial increase in construction cost per classroom, and the energy savings will be substantially less because of the energy consumed by the exhaust fan.
- The cost of a gravity relief economizer is about $700, so the cost justifies the benefit.
- Further, the differential pressure sensors in a power exhaust system require frequent calibration, increasing maintenance costs.

- In addition, the noise generated by the power exhaust fan adds to the classroom noise level.

Static-pressure criteria for economizers and gravity relief systems for small unitary systems should include the following:

- Provide units with downward duct discharge, and with manufacturer-installed and warranted economizer equipment.
- Relief Louver Size: Pressure loss through the louvers should not exceed 0.02" water-gauge static pressure. (Catalog data indicates that the majority of commercially available louvers have about 0.02" water-gauge static pressure drop at about 250 feet per minute free-area velocity.)
- Ceiling Grille Size: Pressure loss through the grilles should not exceed 0.02" water gauge static pressure. (As above, catalog data indicates about 0.02" loss at 300 fpm.)
- Duct Size: Relief duct should be sized for 0.01" water gauge static pressure loss per 100' of ductwork for 100% of the unit capacity. Relief duct total pressure loss should not exceed 0.01" pressure loss.
- Back Draft Dampers: Counter-balanced type that opens at about 0.01" water gauge static pressure. Total pressure loss through the damper should not exceed 0.02" static pressure. (Maintenance procedures should assure that dampers are opening properly and not stuck in the closed position.)
- Total Pressure Drop: Pressure loss through each component of the system must be adjusted so the total does not exceed 0.075" water gauge.

6.5.7 COMMISSIONING MEASURES

6.5.7.1 Air Balance

Systems must be air balanced for both the regular and economizer modes. Most unitary systems are specified with a safety factor in the static pressure. The Contractor must be required by the specifications to replace the drive sheaves and slow the fan down to achieve the required air balance and prevent energy waste and noise. If this is not done, the air flow is left higher, creating higher static pressure and noise levels, including excessive pressure on doors and door closers. If the system is not also balanced for the economizer mode, when the outdoor air dampers are fully open much more air is delivered than the design capacity.

If a corridor HVAC unit is off, or the corridor unit is not in the 100% economizer mode when the classroom is operating on the economizer cycle, the corridor pressure will be lower than normal operating conditions -- further contributing to door closing difficulty. The system must be designed and commissioned to prevent this occurrence.

During testing and balancing, door closer pressures must be set properly and not too low just to more easily achieve access compliance.

6.5.7.2 Remedial Measures for Incorrect Design

If it is found during commissioning that gravity relief is not sufficient during the 100% outdoor air economizer operation after the above commissioning is done, the maximum operation of the return and relief dampers in the economizer system should be adjusted to reduce the amount of outdoor air and return some air to the unit. An 80% outdoor air system is more energy efficient and conducive to fresher indoor air than a minimum outdoor air system with 30% outdoor air.

This is a remediation measure, though, and should be considered a design deficiency.

6.6 COILS AND PIPING

6.6.1 COOLING COILS AND PIPING

Use maximum 550 fpm face velocity for the calculated quantity of air passing through chilled water cooling coils and direct expansion cooling coils.

Size piping at a friction loss of 5" of water per 100' of pipe maximum with maximum velocity not to exceed 9' per second.

Pipe all cooling coils for counter flow of refrigerant against direction of airflow for most effective heat transfer. Chilled water or refrigerant shall enter on the airflow-downstream side of coil and work through rows opposite the airflow. Design for water to enter at bottom and exit through top connection of the coil to relieve possible air binding. Install air vents at top of return riser.

Use 2-way control valves to provide a variable-flow chilled water system. Provide variable speed drives at the pumps to save energy where economically feasible. Provide 3-way valves at the end of each pipe loop for continuous water circulation. Provide a sufficient number of 3-way valves to maintain the minimum flow requirements of chillers. (With multiple chillers, they can be staged to better modulate water flow.)

Provide variable speed drives for the secondary pumps in primary-secondary chilled water systems.

Provide all coil sections with thermometers, a 3/4" globe drain valve piped to floor drain at system low point, a water strainer ahead of control valve, and gate valves in main chilled water supply and return for shutoff and repair of control valves.

Provide condensate piping of copper, piped continuously to a sanitary system drain line.

All valves, fittings, strainers and pipes (up to the coil) shall be the same size, except for control valves, which shall have reducers at valve inlets and outlets. Provide flexible connections at inlets and outlets to coils.

Provide Griswold flow control valves or equivalent at the inlet side of all cooling coils downstream of the shut-off valves. Clearly emboss flow rating on a metal plate fixed on valve housing.

Provide a Venturi flow measurement device, Barco-Aeroquip or equivalent, on main chilled water line. Clearly emboss flow requirement on a metal plate fixed to Venturi housing.

Show direction of air flow through coils on diagrams.

Size chilled water coils on a basis of 12°F to 16°F water temperature rise.

Use direct expansion (DX) coils where close temperature control is not required. Direct expansion coils make control of cold plenum temperature erratic and present operational difficulties.

- Provide as many steps of capacity with solenoid valves as possible and use individual suction risers with oil traps.
- Pipe liquid lines with stop valves, strainers, solenoid valves, and external equalizing thermal expansion valves.
- Install sight glasses ahead of thermal expansion valve to observe a premature flashing condition.

6.6.2 HEATING COILS AND PIPING

Use maximum 700 fpm face velocity for the calculated quantity of air passing through heating coils.

Use hot water as the preferred heating medium rather than steam. (Steam coils have relatively poor heat distribution across the face, particularly on low heat demand.)

Use 2-way control valves to provide a variable flow hot water system. Provide variable speed drives at the pumps to save energy where economically feasible. Provide 3-way valves at the end of each pipe loop for continuous water circulation. Provide a sufficient number of 3-way valves to maintain the minimum flow requirements of boilers. (With multiple boilers, they can be staged to better modulate flow.)

Arrange heating coils for counter flow and upward flow for best heat transfer and natural venting. Tailor coils for each project with sufficient allowance for warm-up and fresh-air loads.

Size water coils for 20°F minimum water temperature difference, and entering water temperature of 180°F.

Piping criteria for hot water coils shall be the same as those for the chilled water coils.

6.7 COOLING SOURCES

6.7.1 REFRIGERATION SYSTEMS

Because it is difficult to obtain modulating control of capacity, direct expansion (DX) systems should be used only for single zone units and other applications where modulation is not necessary.

Chilled water systems should be used for most multi-zone units and larger systems, where more precise control and better capacity modulating control is needed.

Package units with compressor, chiller, condenser, and controls all provided as a unit should be used wherever possible to simplify installation.

Machines should be piped for parallel flow.

Select evaporators and condensers so water velocity through tubes is 9’ per second maximum.

Absorption chillers should only be considered if steam is available from a central plant that will be operating during summer or special gas incentives are available.

Thermal energy storage systems and cogeneration systems should only be considered when substantial incentives are offered by the utility providers to offset the additional capital cost.

6.7.2 CHILLED WATER PUMPS

Size pumps for the total pressure drop through the system, including piping, chiller evaporator, coil, three-way control valve and "Griswold" flow control valve.

Use two chilled water pumps in parallel for most systems and all systems of more than 75 tons, or where a critical operation needs a standby. Design system for 100% capacity with both pumps operating; and so one pump will then provide 75% to 80% of capacity.

Use end suction, pedestal mounted pumps with mechanical seals and flexible couplings for all except very large systems, where it may be necessary to use double suction pumps.

Install a service valve and strainer on the suction side and a balancing valve on the discharge side of each pump, and a chemical feeder from the supply to return line. In general, use full-size ball valves for HVAC system applications.

Bolt pumps directly to a concrete base unless located over or under a critical occupied space, when they should be mounted on inertia anti-vibration bases. Install flexible connections in piping to pumps.

6.7.3 COOLING TOWERS

Size cooling towers for 120% to 150% of required capacity, to guarantee full capacity from chiller at any wet bulb conditions and to allow for fouling of tower.

Provide a bleed-off system and a chemical feeder to prevent mineral build up and to maintain water quality.

Provide for make-up water to replace evaporation and bleed.

Locate cooling towers so that the discharge air from the cooling towers will not contaminate air handling unit outdoor air intakes, openings into the building and pedestrian or student occupied areas to minimize the possibility of Legionnaire Disease.

Locate cooling towers to avoid unsightly conditions and so that noise generated by fan will not be objectionable in adjoining buildings. Provide louvered screens, masonry walls, or planting for concealment. Provide security from vandalism with walls, fencing, and lockable gates.

6.7.4 CONDENSER WATER PUMPS

Use two condenser water pumps in parallel for large systems of more than 100 tons, or where a critical operation needs a standby. Design system for 100% capacity with both pumps operating, and so one pump will then provide 75% to 80% of capacity.

Size pumps for the actual capacity of the chiller requirements at approximately 3 gpm per ton of refrigeration.

Make sure that cooling tower elevation or suction pipe sizes are adequate to provide a positive suction head at the pump.

Piping criteria for condenser water piping shall be the same as those for the chilled water piping.

6.8 HEATING SOURCES

6.8.1 BOILERS

Use low-nox hot water boilers to avoid expense of heat exchangers.

Use cast iron or steel water tube boilers with burner and controls all mounted as a unit.

Use two or more gas fired package boilers, for larger systems and one for smaller systems.

Provide staging controls for multiple boiler installations, with central control thru the DDC system.

Operate at 180°F to 200°F minimum with a temperature drop of 30°F maximum to prevent condensation of flue gases in breeching and stack.

Provide a combination low-water cutoff and boiler feed control with alarm mounted above center line of boiler relief-valve discharge.

Connect boiler feed to full domestic cold water line pressure, taking care to see that CW pressure is greater than boiler operating pressure.

Pipe blow down from low water control and feeder to a hopper drain located adjacent to boiler.

6.8.2 HOT WATER HEATING SYSTEM

6.8.2.1 Central Steam Boiler Plant

Steam from a central plant should be used if available. Provide heat exchanger to convert steam to hot water for heating buildings.

6.8.2.2 Circulating System

When using a heat exchanger for one coil bank, use a single pump to circulate a constant quantity of water through coil and heat exchanger. Hot plenum controller should control steam valve at the heat exchanger.

For larger systems, where more than one coil bank is served by one heat exchanger or where a hot water boiler is used, use a primary reverse return hot water heating system

wherever economically feasible. A secondary circuit and secondary pump at each heating unit or coil bank should be used if close temperature control is required. Secondary pump should circulate a constant quantity of water through heating coils. In most instances, though, a secondary pump is not required.

Supply water at 180°F with a 20°F temperature drop minimum.

6.8.2.3 Pumps

Use two pumps in parallel on primary circuit for all but very small systems. Design system for 100% capacity with both pumps operating; one pump will then provide 75 to 80% of capacity as standby.

If close temperature control is required, select circulating pumps first and size piping to fit available pump head. In most cases, this will permit use of pipeline mounted pumps for all secondary circuits. Close temperature control is usually not required and secondary circuit pumps are usually not necessary.

Use end suction, pedestal mounted pumps with mechanical seals and flexible couplings for all except very large systems, where it may be necessary to use double suction pumps.

Bolt pumps directly to a concrete base unless located over or under a critical occupied space, when they should be mounted on inertia anti-vibration bases. Install flexible connections in piping to pumps.

6.8.2.4 Piping

Design for water velocity of 8’ per second maximum, with pressure drop 5’per 100’ of pipe maximum.

Arrange piping so heat source, expansion tank and cold-water makeup are on suction side of pump as indicated in latest ASHRAE Handbook, Systems Volume.

Install a small chemical feeder on each system.

6.8.2.5 Expansion Tanks

Size expansion tanks in accordance ASHRAE Guidelines for 100 psi ASME Code working pressure. Expansion tanks shall be the bladder or diaphragm type.

6.8.2.6 Relief Valves

Provide ASME Code rated relief for maximum heat input to hot water boiler.

For steam heat exchangers, capacity for relief valve may be sized for 25% of heat output providing steam pressure to heat exchanger is not greater than working pressure of weakest component in system.

Relief setting is limited to boiler working pressure or working pressure of weakest component in system.

Pipe discharge to floor sinks.

6.8.2.7 Air Vent Valves

Provide manual air vent valves at all high points in system or wherever air might be trapped in system. Show valve locations on drawings.

6.8.3 STEAM HEATING SYSTEM

Steam may be used for a single zone heating and ventilating unit piped directly to steam coil. Steam pressure available is normally 10 psi and steam valve sized for approximately 7 psi pressure drop at full load.

Use steam distributing type coil sized on 2 psi steam supply. All coils and other steam heated equipment should be located so they can be drained by gravity to receiver of condensate pump. Use condensate pumps and avoid vacuum pumps.

Design steam and condensate piping systems to accommodate capacity and other requirements of equipment to be served and to allow for future expansion.

6.8.3.1 Steam and Condensate Piping

Size piping in accordance with the ASHRAE Fundamentals Handbook.

Design steam so total pressure drop in steam line does not exceed 20% of initial pressure.

After establishing total pressure drop, determine allowable loss per 100’ of equivalent pipe.

- For radiator systems having a number of fittings, assume equivalent length to be twice the measured length.
- For coil systems having a small number of fittings, assume equivalent length to be 1½ times measured length.

Pitch steam mains down in direction of steam flow ½" in 10’.

Drip all low points of steam mains through suitable traps. Provide a schedule of steam traps indicating pounds of condensate per hour, differential pressure, operating pressure, and type of trap. Oversize traps 2 to 5 times the hourly rate of equipment to allow for pickup and intermittent operation of trap.

Size branches to heating equipment according to charts supplied by equipment manufacturer and as directed by District.

Slope branches back toward main not less than 1" in 10’. Where runouts or branches are over 10’ long, make them one size larger than indicated on chart. Do not use bullhead connections.

Design for thermal expansion using expansion loops in preference to expansion joints wherever possible. Divide piping into sections with anchor points at the beginning and end of each section, and at the boiler and major pieces of equipment. Calculate the stress on the piping in each section and add expansion joints if the allowable piping stress is exceeded.

Where steam mains must be pitched so that condensate flow is counter to direction of steam flow, check allowable steam velocity and oversize pipes in accordance with ASHRAE Fundamentals Handbook.

Design condensate piping for gravity flow to receiver of condensate pump.

6.8.3.2 Condensate Pumps

Use duplex condensate pumps sized so one pump will handle load running one third of time with other pump as standby. Provide a mechanical alternator to alternate pump operation and to activate second pump in case first can not handle load.

Design system so that condensate pump receiver is below all traps and equipment to obtain gravity flow. Elevate equipment such as heat exchangers and hot water tanks so they are higher than pumps.

Design pump to meet all discharge pressure requirements, including piping friction losses, vertical lift to elevated receivers or feed water heaters, and the intermittent discharge of other pumps into the same piping system.

6.8.4 COLD WATER MAKEUP

Cold water makeup to boilers, hot water, chilled water, and condenser water systems should be made from a common line, which has a reduced pressure backflow prevention device installed under plumbing work.

Install a gate valve, strainer and check valve at makeup connections to closed systems, except that makeup to combination boiler water feeder and low water cutoff on boilers should be full line pressure.

Provide water treatment for all closed heating and cooling systems and at all cooling towers.

6.9 SOUND AND VIBRATION CONTROL

6.9.1 CRITERIA

Because mechanical systems and equipment are a major source of disturbing noise within buildings, sound and vibration control measures must be incorporated to the maximum extent economically practical.

In general, refer to current ASHRAE guidelines and acoustical recommendations of this ADM, and the following recommendations.

The District desires to achieve background noise levels from HVAC systems in instructional spaces lower than 45 dBA. Plan and describe in the **"Basis of Design"** narrative how this improved acoustical quality will be achieved together with the associated cost impacts.

For all special conditions, an acoustical consultant shall be engaged to advise on sound reduction measures.

6.9.2 EQUIPMENT SOUND LEVELS

Schedule the sound level of the design base HVAC equipment on the drawings. These sound levels must be at the design conditions and tested per applicable current standards such as ARI Standards 260, 270, 370 and AMCA 300.

6.9.3 DUCTWORK

Choose ducts of thicker sheet metal gauge and use sound attenuators to reduce fan and equipment noise. Lined ductwork may be used when recommended by the project acoustical engineer.

Duct lining, acoustical panels in ductwork, and sound attenuator media, when used, shall be the type that inhibits growth of mold, mildew and fungi, and does not contain harmful VOC or glass fiber.

Provide flexible connectors for ducts at fan connections.

Sound attenuators or lined ducts should be installed on inlet and outlet side of fans and between fans and ducts to prevent fan noise entering rooms through the duct system. Do not locate sound attenuators in ducts above the ceiling of classrooms or similarly occupied spaces, where breakout noise will increase indoor noise levels.

6.9.4 FANS

Fan noise in occupied spaces is typically caused by poorly constructed roof fans, fans operating at too great a tip speed, fan noise traveling through air intake louvers and then into adjoining spaces, and fan noise traveling to occupied spaces through inadequately treated return systems.

Fan noise also comes from rooms without sound attenuating walls or from roof-top units with inadequate sealing of roof openings and duct chases.

Locate fan and equipment rooms away from classrooms and other noise sensitive spaces.

Make fan and equipment room walls of dense material, poured concrete or concrete block with all voids filled where feasible, or sound attenuating walls of studs, sound insulation, both within the stud cavity and in the fan room, acoustical calk all wall perimeters. Minimize or eliminate all penetrations for conduit and pipes. Provide multiple layers for gypsum board and sound insulation, resilient clips etc. as required to achieve sound ratings required by the acoustical consultant retained by the architect.

Provide details to assure adequate sealing of duct penetrations through roof or mechanical equipment room walls.

At roof fans exhausting from ceiling plenums over occupied areas, provide a sound attenuator installed at fan inlet.

6.9.5 EQUIPMENT MOUNTING AND ISOLATION

Mount all package rooftop units on vibration isolation curbs. Use manufactured curbs that are custom fitted to both the roof deck and to the HVAC equipment. Specify in

"Roof Accessories," Section **07 72 00**, not in "Mechanical" work. **(Coordinate with Architectural personnel.)**

Curb Manufacturers: MicroMetl, Roof Products, Inc.; The Pate Co.; EZ Curb Adaptor.

For rooftop units, assure that there are no roof penetrations except the minimum necessary for ducts, electrical conduit, or other required service lines. All such openings shall penetrate inside roof curbs and shall be sealed with acoustical sealant.

In addition, beneath the units provide a sound isolation barrier of a close fitting layer of ¾" waterproof (i.e pressure treated and/or fire treated) CDX plywood or cement board, sealed with acoustical tape to the curb.

For fans, over 24" provide inertia type concrete bases with spring isolators. For smaller fans, provide spring type vibration isolator rails under fan and motor.

Floor mounted pumps shall be bolted directly to concrete bases and shall have flexible pipe connections, except when located over or under an occupied area where noise could be transmitted by piping or building structure to occupied space. In this case, they shall be mounted on inertia type concrete bases with spring-type vibration isolators and shall have flexible connections rigidly anchored and braced to prevent elongation of the flexible connections.

Air compressors shall be mounted on spring-type vibration isolators, except larger sizes shall also have concrete inertia bases and flexible pipe connections.

6.9.6 PIPE, CONDUIT AND DUCT CONNECTIONS TO HVAC EQUIPMENT

Provide flexible connectors at all pipe, duct and electrical conduit connections to HVAC equipment with rotating or reciprocating components.

Provide spring, neoprene or rubber in shear type hangers for pipes and ducts near connections to HVAC equipment that are located near or serve acoustically sensitive spaces.

6.9.7 CLASSROOM HVAC SOUND CONTROL

HVAC systems must be designed so that noise from the system does not cause the background sound level in a classroom to exceed 45 dBA as measured in accordance with ANSI Standard 12-60. Make design recommendations to the District to achieve an even lower sound level, within reasonable economic limits.

ASHRAE recommended design criteria for classroom HVAC sound control is Noise Criteria (NC) Curve NC-35. An HVAC system will probably meet the District 45 dBA criteria when no portion of octave band spectrum of noise lies above the NC-35 curve. (This is approximately equivalent to a sound level of 45 dBA from a standard sound level meter reading.)

Since a significant source of noise is break-out from ductwork, coordinate with architectural personnel to provide duct enclosures that block the sound from entering the classroom – for example, framed and dry walled soffits.

6.10 SPECIAL CONSIDERATIONS

6.10.1 TOILET ROOM VENTILATION

Provide a minimum of 10 air changes per hour in toilet rooms.

In multi-occupant toilet rooms, provide conditioned air using relief air from adjoining air-conditioned spaces, using back draft dampers. Provide fire dampers as required to meet all applicable code requirements.

6.10.2 HVAC AND REFRIGERATION FOR FOOD SERVICE

Kitchen ventilation systems shall comply with the current CMC requirements.

Exhaust all air introduced into a food service kitchen. With minor exceptions, all air is exhausted through kitchen hoods.

Provide supply air for heating and ventilating by a gas fired heater, controlled by a room thermostat unless otherwise approved by the District.

In general, provide supply air for cooling by an evaporative cooler unless otherwise approved by the District. For project specific kitchens, air conditioning may be necessary, instead of or to supplement the evaporative cooling system. Obtain written direction from the District for such installations. Locate and specify control switches for HVAC equipment to prevent unauthorized use.

6.10.2.1 Kitchen Hoods

Provide UL listed stainless steel hoods of the 100% exhaust type. Short circuit hoods where makeup air is introduced directly into the hood are not allowed.

Provide a State Fire Marshal approved fire protection system inside hood (see the Fire Protection section of the ADM).

6.10.2.2 Walk-In Refrigerators

Standby refrigeration equipment for walk-in boxes is not usually provided, so accessibility is critical for maintenance and repairs.

Do not locate in areas difficult to reach or service.

If located outside, protect from direct sun.

6.10.3 HVAC FOR SCIENCE CLASSROOMS

Science classrooms include chemistry, physics, biology, physiology, physical earth, and earth science study facilities as well as prep rooms, work rooms and storage rooms adjacent to labs.

Where hazardous or toxic substances are used or stored, special precautions must be taken, including the following:

- Direction of airflow must be controlled to prevent spread of airborne contaminants and to protect personnel from exposure to toxic and hazardous substances.
- Exhaust 100% of air supplied with no recirculation.

- Maintain constant airflow volume with exhaust operating at full capacity.
- If contaminants are exhausted to the atmosphere, the exhaust air must be treated.
- Air supply system must satisfy thermal requirements and provide necessary air balance.

6.10.3.1 Hood Exhaust System

Exhaust fans must remove a fixed air quantity from each hood. Hoods that have doors must have individual bypasses for air volume and face velocity regulation.

Exhaust system may consist of an individual fan for each hood or a fan serving a group of hoods.

Determine if there is a need for off hour operation of hood exhaust system, and design the system accordingly.

Locate exhaust fans near the point of discharge to atmosphere so ducts will be under negative pressure and any leakage will be into duct.

Locate discharge openings with respect to fresh air intakes to avoid recirculation.

Exhaust ducts and fans must be of non-corrosive construction. In all cases, follow the hood manufacturer's recommendations for exhaust fan sizing and system design.

Provide explosion proof exhaust fans where required by applicable Codes.

6.10.4 HVAC FOR COMPUTER ROOMS

Provide HVAC to MDF, IDF, and any other computer rooms having special requirements for temperature and air quality control.

The computer room HVAC units shall be for 24 hour operation, independent from any central system. Roof-top gas/electric units are preferred, but heat pumps with roof-top condensers are acceptable.

6.10.5 HVAC FOR ARTS CLASSROOMS

6.10.5.1 Photography Classrooms

Supply dark rooms with 100% outdoor air for control of odor.

Since air must be extremely clean to avoid spotty film, use high-efficiency filters. Provide MERV rating to District for approval prior to specifying.

Duct systems into dark rooms must be light tight.

6.10.5.2 Art Classrooms

Provide generous exhaust to remove fumes from oil painting, lacquer, cleaning solvents, etc.

6.10.5.3 Ceramic Classrooms

For kiln, products of combustion must be removed, and a source of combustion air provided for gas fired models located indoors. Since they emit large quantities of heat,

that load must be considered in HVAC design. Locate kilns outdoors under roof wherever possible.

6.10.6 HVAC FOR INDUSTRIAL ARTS CLASSROOMS

Industrial Arts Classrooms are spaces provided for instruction in construction, maintenance, and repair of industrial products. In addition to California Code of Regulations (CCR) Title 24, refer to CCR Title 8, Industrial Relations for additional design criteria.

6.10.6.1 Power Energy Technology

Power Energy Technology shops require large amounts of heat to replace losses through large and frequently opened doors.

Since work is often done underneath automobiles or other equipment, floors should be kept warm by radiant heating or other devices, such as overhead radiant heaters near roll up doors.

Provide an underfloor carbon monoxide exhaust system to remove engine exhaust gases. Overhead carbon monoxide exhaust system may be used where budget is limited with prior approval of District.

If a paint spray booth is installed, it must be exhausted in a safe manner. Makeup air to spray booth must be tempered for best painting results.

If a steam cleaning area is provided, it must be exhausted.

6.10.6.2 Construction Technology Shops

Dust produced in wood working operations is both a health and fire hazard. In smaller installations, a packaged dust collector using a vacuum cleaner principle may be provided. Large groups of wood working machines will require a ducted, central collection system with a centrifugal separator. In either case, collection equipment must be located so that disposal of collected dust is easy and economical. Dust collection system should include the following:

- Exhaust pipe system including dust collector and skimmer must be included.
- Avoid under floor piping.
- Keeps flexible exhaust piping to a minimum. Where used, install a no collapsible type of piping. (Use flexible heavy-duty rubber hose where applicable.)
- Drop exhaust piping along columns or walls.
- Note minimum height of hopper outlet for placement of 55-gallon drums.
- Note maximum height of exhaust piping inlet to dust collector on existing building where exhaust piping may penetrate existing building window.
- Coordinate exhaust piping with suspended light fixtures, which are free to swing a minimum of 45 degrees from vertical in all directions.
- Provide seismic restraints for exhaust piping per provisions of NFPA Pamphlet 13.

- Refer to standards and requirements of ACGIH Industrial Ventilation - A Manual of Recommended Practices - AMCA, and SCAQMD, as applicable.

For spray painting, provide a bench type or floor type spray booth.

Heating system must be large enough to accommodate outdoor air provided to equal exhaust quantities.

6.10.6.3 General Manufacturing Shops

General manufacturing shops may contain high heat producing equipment such as furnaces and ovens. Locate outdoors under roofs wherever possible. These must be shielded or ventilation must be provided to control local environment.

Welding and soldering operations produce toxic fumes, which must be removed through hoods or other local exhaust.

Dip tanks and plating tanks must be hooded to prevent spread of toxic vapors.

6.10.7 UNDERGROUND PARKING VENTILATION

Use light and air wells and other devices to meet minimum code for natural ventilation and avoid mechanical ventilation system.

Ventilate underground parking areas by forced air exhaust systems in compliance with current codes. Provide make up air only where required by agencies having jurisdiction

Provide carbon monoxide monitors to control the exhaust fans and to annunciate an alarm on high CO levels.

Design ventilation system so that there will be no dead spots. Locate fan(s) in fan room(s) or enclose fan(s) with chain link fence for vandal protection.

Assure that exposed ducts or equipment are protected by bollards or other enclosure.

Exercise care in locating exhaust grilles which are considered an industrial pollutant in some jurisdictions.

Carefully design location of natural ventilation locations to meet code for open parking structures so that roll up fire doors and fire walls are not required at every second level.

6.11 TOILET ROOM VENTILATION

Provide makeup air from corridors with transfer grilles with fire dampers or supply ducts. Exhaust through roof wherever possible. Where side wall exhaust must use, locate away from operable windows and doors. If in high wind areas locate side wall exhaust grilles on leeward side or provide hoods.

7. ELECTRICAL POWER AND LIGHTING

7.1 GENERAL REQUIREMENTS

Life safety and preservation of property are two critical factors in the design of the electrical system. Safety to personnel can not be compromised and only the safest systems must be considered.

The District will provide the Architect with available electrical drawings and underground utility plans for existing sites. Other site plans or site information that may exist are available in the District office for consultants' research. The Architect must visit the site to verify the indicated information and to obtain information not indicated on the drawings.

Offsite work or work within easements shall be designed in accordance with the requirements of the agency having jurisdiction.

Electrical power service to each building shall be routed through one main distribution panel location within a dedicated electrical power room in that building to provide direct access for service and control of the electrical power systems in the building.

All panels and control equipment must be accessible from floor level, without the need for ladders or other access equipment.

Electrical receptacles and light switches shall be located to allow easy access by users that reflect probable area uses and equipment locations. Receptacles or switches serving equipment must be accessible with the equipment in place and not behind the equipment.

Provisions shall be made for wire management of power cords and shall be coordinated with the work surfaces, counters, cabinetry, storage units, etc.

Low-voltage communication or signal wiring shall be continuous without splices between devices. Wiring shall be in conduits or cable trays, except for local distribution within rooms, where suspension devices may be used and wiring must be organized and run parallel to walls. Drops in walls shall be in conduit. Wire mold may be used for computer outlets on walls. (Refer to ADM Section "Electrical Communication and AV Systems" for additional requirements.)

Provide assurance that all suspended or pendant luminaries meet seismic design requirements.

Avoid roof mounted conduit wherever possible.

Specify the work of this section in Division **26 00 00, Electrical,** in accordance with CSI Master format 2004 Edition.

7.2 LIGHTING SYSTEMS

7.2.1 GENERAL GUIDELINES

Lighting design shall conform to California Energy Commission Energy Efficiency Standards for nonresidential buildings, and shall achieve even greater efficiency in accordance with the requirements described below.

Lighting design shall comply with guidelines and follow recommendations and procedures of the Illuminating Engineering Society of North America (IESNA) in its "Lighting Handbook" and "Recommended Practice on Lighting for Educational Facilities, ANSI/IESNA RP-3-00," as well as other documents referenced herein.

Refer also to alternative design approaches and delighting requirements presented in ADM Section "Environment and Sustainability."

For other guidelines, refer to "CHPS Best Practices Manual, Volume II," sections on "Electric Lighting and Controls" and "Appendix" as well as the electric lighting credit in Volume III, "Criteria" (available at http://www.chps.net/).

Provide uniform light distribution of all surfaces in learning and working spaces. Interior lighting systems shall provide illumination without discomfort caused by glare. Consider reflectance of room surfaces and coordinate with architectural finishes.

Avoid harsh or extremely bright lighting. Minimize veiling reflections in task details.

Utilize day lighting to the maximum extent feasible in all spaces, integrated with electric lighting and photo sensors to reduce electricity use.

Utilize high color rendering sources in which appearance of people and spaces is enhanced.

Consider maintainability of lighting system, including susceptibility to dirt collection, ease of cleaning and relamping.

Provide in all display cases lighting to illuminate each shelf and back individually.

7.2.2 ILLUMINATION CRITERIA

In general, design to achieve the following minimum average maintained foot candle (fc) levels on the task plane (or minimum fc level where indicated), unless alternative lighting designs are submitted and approved by the District that demonstrate compliance with these criteria.

∞ General Classrooms	35–40 fc	Linear Susp. Fluorescent
∞ Science/Technology Classrooms	35--40 fc	Linear Susp. Fluorescent
∞ Shops and Drafting Classrooms	45--50 fc	Linear Susp. Fluorescent
∞ Library	35–40 fc	Linear Susp. Fluorescent
∞ Multi-Purpose Room (General)	35 fc	Fluorescent or Dimmable HID
∞ Gymnasium	50 fc	Fluorescent or Dimmable HID

∞ Locker, Exercise & Weight rooms:	30 fc	Fluorescent
∞ Dining areas (on dimmers)	30 fc	Fluorescent
∞ Food Preparation Area	50 fc	Fluorescent
∞ Custodial Rooms	20 fc	Fluorescent
∞ Offices	35-50 fc	Fluorescent
∞ Corridor/Stairways	10 fc	Fluorescent
∞ Restrooms	10 fc	Fluorescent
∞ Building Ext'r (Walks, General Areas)	2 fc min.	Fluorescent or LED
∞ Exterior Corridors (Covered Walks)	10 fc min.	Fluorescent or LED
∞ Parking Lots (exterior)	1 fc min.	
∞ Athletic Field	50 fc min.	
∞ Emergency Exit Lighting	1 fc min.	Fluorescent or LED
∞ Parking Structures	7fc preferred, 5fc minimum, 15-20 fc	Fluorescent
∞ Parking Structure Entrances		

7.2.3 CLASSROOM LIGHTING SYSTEMS

Follow the recommendations of the Southern California Edison "Classroom Lighting Guidelines" except as modified herein.

Classroom lighting shall be an integrated combination of daylighting and electric lighting providing energy conservation through lighting controls. (See also ADM Section "Environmental and Sustainability" standards.)

The typical classroom model to meet or exceed the criteria will consist of two rows of continuous suspended indirect or indirect/direct fluorescent luminaires parallel to the window wall. (Three rows are excessive and will produce larger than necessary lighting power densities.) In a typical 32' x 30' classroom, this will be:

∞ Each row 20' long, plus a 12' whiteboard luminaire.

Or

∞ Each row 24' long, arranged to provide illumination of the teaching wall and white boards,

Lamps in each row for general illumination shall be two high output T8 lamps or one dimmable T5HO lamp with matching ballasts. Ballasts will usually have a normal ballast factor. See this volume's Section "Lighting Controls."

Align suspended rows and supporting cables with the ceiling grid. In a typical classroom, rows will be spaced 14' apart. However, vary the length and spacing of the two continuous rows of luminaires to suit the actual size and shape of the classrooms as well as specific functional needs.

For larger science, technical and arts classrooms use a similar model, but use longer rows. Since these rooms sometimes have perimeter work counters, and the luminance should be greater over the counters, adjust the spacing to adequately illuminate the counters. Use a higher ballast factor if necessary to increase the illumination.

In secondary-school science, technical and arts classrooms use a dual-mode fixture with two T8 indirect lamps for general illumination and one dimmable T8 down light for AV presentations. Lamp rows must be switched so that both lamp sets cannot be on at the same time. Use a whiteboard luminaire in these classrooms.

Dual-Mode Luminaire: Prudential Lighting WAVE Louver (with Dual Optics)

Prudential Lighting Pru-15 (with Dual Optics)

(Repr.: Prudential Lighting Products, Crissy Cosci, 626-482-8420, www.plpsocal.com)

Luminaires must illuminate the ceilings and walls as well as the task plane (desktop).

Uniformity of luminance on the desktop is important – especially on the core desk space, beginning four feet from walls. Generally, a maximum: minimum ratio of 2.5:1.0 should not be exceeded.

Provide ceiling luminance equal to or greater than the desktop luminance. Uniformity of ceiling luminance is important, and the maximum ratio should not exceed 12:1. Provide wall luminance (opposite the window wall) approximately 50% or more of ceiling luminance.

Provide teaching wall and white board luminance at 20 fc minimum. When using wall-washing whiteboard luminaires, illumination of the instructional wall (whiteboards, maps, etc.) should be 30 fc minimum to 40 fc maximum.

Wall-washing whiteboard luminaires shall be selected and located in accordance with IESNA recommendations, to avoid reflections in the board to the nearest viewer, to avoid a bright patch above the board, and to evenly illuminate the board without a steep fall-off toward the bottom.

Provide lighting calculations in the Design Development Phase that graphically demonstrate the light levels on all room surfaces, calculated using the point-by-point method, with average and maximum figures. Use the input data presented in the SCE "Classroom Lighting Guidelines," except for any modifications in this School Design Standards.

Lighting power density (LPD) in the classroom shall not be greater than 0.85 watts per square foot (w/sf) connected load.

7.2.4 GYMNASIUM LIGHTING

Illuminate gyms with top daylighting for daytime use (not side lighting through windows), using skylights or tubular daylighting devices.

Using average lumen output of the daylight device for the brightest 2,400 hours of the year (based on TMY2 weather data), design day lighting to provide 30 to 35 fc average on the floor with a maximum: minimum ratio of 2:1 all within reasonable tolerances.

Provide electric lighting for night time use and day time supplementary lighting using high bay or high output fluorescent luminaires (T5HO lamps) or switch able metal halide luminaires, accompanied by daylight sensors to selectively switch the lamps in response to the daylight luminance. Lamps shall be switch able to three (minimum) levels including "OFF", with switching controlled to rotate use of the fluorescent lamps to give equal wear to each lamp. Fixtures with alternative light sources may be used with justification and approval in writing from the District.

7.2.5 SITE LIGHTING

Campus and parking areas and building perimeters must be lighted to provide for the safety of people and the security of property. Provide adequate light, properly distributed to reveal such hazards as curbs and steps, and to illuminate dark and potentially dangerous areas.

Provide safety and security lighting on exterior walls of buildings, building entrances, parking lots, covered walks, and where needed to meet specific project requirements.

Provide lighting for parking lots using pole mounted full-cut-off luminaires.

Luminaires must be installed in such a manner as to minimize glare for pedestrians and drivers, and to avoid light spilling onto adjacent properties.

Exterior luminaires and controls, including those located in stairwells open to the exterior, shall be weather resistant and vandal resistant. Locate luminaires and sensors at 10 feet or more above grade wherever feasible, or otherwise as high and out of reach as possible.

7.2.6 SPORTS FIELDS LIGHTING

For sports fields, the luminance must satisfy the requirements of players and spectators. Uniformity of horizontal and vertical illumination over the entire playing field is especially important for such high-speed sports as baseball, football, and tennis.

Important factors include glare, luminance contrast, color contrast, flicker and spill light.

Luminaires must provide spill and cut-off controls to minimize offsite luminance and glare and sky glare.

7.2.7 STAGE AND AUDITORIUM LIGHTING

A Theatrical Lighting and Sound Consultant must be engaged by the Architect as a part of Basic Services for the design of these systems for high school auditoriums and where requested by the District in middle school and elementary school multipurpose rooms and platforms.

The requirements that follow are scalable for different sizes and functions of auditoria and multi-purpose rooms, for elementary and secondary schools. The architect shall submit a concept showing provisions for all requirements, with a scaled back development that allows the project to meet budget limitations, while still providing for future augmentation to the ultimate scope.

Lighting and controls are required for stages and platforms, house lights (seating area), work lights, and orchestra pit lights.

All stage and auditorium lighting must be easily and safely accessible for re-lamping and servicing. Such provisions must be clearly indicated on the drawings.

Proscenium stages and platforms require stage lighting from the front, side and back. Front lighting is in the auditorium seating area, or "house," before the proscenium. On-stage lighting is within the stage area itself.

Stage lighting equipment can be either completely visible to the audience or completely concealed. If the equipment is mounted in visible locations, consider instrument spill light, glare and nearby reflective surfaces in the design.

The most common -front lighting for stages is overhead in the auditorium ceiling, in a ceiling cove or beam position. This is plotted on a 45° degree angle from head height (approximately 5 feet of an actor standing at the proscenium line) to the auditorium ceiling. Lights located in this position provide the basic illumination for the downstage acting area. In a large auditorium, several ceiling slots may be required to provide adequate lighting on the forestage or apron, and the area immediately behind the front curtain.

Side lighting supplements the overhead lighting to give three dimensional properties to the performers and setting. This lighting equipment, usually ellipsoidal spotlights, is mounted on a pipe frame secured to the wall at each side of the auditorium. These positions are called box booms and the lighting is intended for the apron area only or cross lighting for deeper into the stage.

Side light for the remaining acting area (behind the proscenium arch) can either be from positions on the end of electrical battens in the air or on separate movable boom poles in between each wing (this low side light is most commonly utilized for dance).

Onstage lighting provides front, upstage, top, high side, back lighting, as well as scenery and cyclorama lighting. The principal lighting equipment for onstage lighting consists of rows of PARs, ellipsoidal spotlights, fresnels, and cyclorama lighting on overhead electric battens.

The number of batten rows and lighting equipment depends on the size of the stage. Typically, one electric batten is supplied for each 8 feet of acting area depth for front light. At a minimum, one additional electric is needed for the last row of acting area back and side light. If there is a cyclorama, or background scenery, another electric batten will be needed for those lights.

In the onstage area, 2- and 3-circuit floor pockets need to be provided for low side lighting. Typically, for a medium size stage, provide approximately 8 floor pockets distributed along the side and backstage areas. In addition, floor plates or movable booms with weighted bases and side arms should be provided.

Border lights shall be provided as recommended by the Theater and Lighting Consultant.

Coordinate stage lighting with curtains, draperies, grid beams, counter weight suspension, and light battens to assure that border lights and cables are concealed and properly supported.

In addition to the stage lights, dimmable house lights and switch able stage work lights must be provided for general illumination during rehearsals, scenery setting, and other activities outside performance.

For auditoria to be also used for lectures and testing, provide supplemental fluorescent lighting. (Pulse start metal halide may be considered.) The supplemental lighting shall be turned off automatically by dimmer bank controls during performance.

Provide orchestra pit lighting and receptacles for pit lights when pits are provided.

Provide emergency lighting supplied from central battery/inverter system to provide minimum 1 foot candle throughout the exit aisle areas for exiting. Use overhead fixtures (some of the non-dimmed house or supplemental fixtures), which are normally off, and only turned on automatically in case of loss of power.

Provide LED aisle lighting at stairs and aisles in auditoriums.

Manufacturer: Electronic Theater Control (ETC).

7.2.7.1 Planning Flexibility for Theatrical Lighting

Every space with a stage should include front lighting with dimming and control.

The following elements can be included as the program and budget allow, in order of priority as follows:

1. Back light
2. Background scenery light
3. High side light
4. Box boom
5. Low side light

For a larger auditorium and stage, every effort should be taken to include as many elements above as possible, working down the list to insure that the highest priority takes precedent. The smaller the space gets (along with the budget), the more elements can be taken off the list.

If there is an attic over multipurpose rooms and auditoria, provide top access lighting fixtures, catwalks and attic lighting.

7.2.7.2 Theatrical Lighting Provisions

Each theatrical fixture should be hung by a theatrical c-clamp onto a schedule 40 black pipe. This shall allow the relocation of each fixture depending on the performance or the production designer's needs.

Provide each hanging fixture with a theatrical safety cable.

Provide each fixture with a cord and theatrical plug (Twistlock or Stagepin, whichever matches outlets specified on raceways).

Provide each fixture with gel frame for color.

Provide a variety of accessories such as barn doors or pattern holders.

Near each position pipe or attached to each pipe, provide distributed electrically housed outlets provided by the supplier of the theatrical lighting and control system. Each theatrical raceway should house enough circuits and receptacles to plug in each fixture located there separately, with a minimum of 1 or 2 spares. Raceways can be provided with pigtails (if not seen by the audience) or with flush receptacles.

All raceways should be electrified with a large single cable or conduit run. All circuits should be clearly labeled. Circuit numbers should begin at the front of house and increase sequentially as they progress towards the stage. Circuit numbers should correlate one to one with their respective dimmer.

Provide at least a single dimmer for each circuit. Common dimmer rack sizes are 96, 48, 24 and 12, or any combination thereof. Typically, they consist of 3-phase power and accept a 40-200 amp feed depending on size and load.

7.2.7.3 Controls

To control the operation of the lighting equipment, a dimming system and control system must be provided. The dimming system typically consists of dimmer racks that include dimmer modules and control modules, a lighting control console, and stage manager panels.

Locate dimmer racks in a locked, well ventilated room where the ambient temperature does not exceed 30°C (86°F). (Provide air conditioning to match thermal load.)

Locate the control console in a control room at the rear of the auditorium seating area above the level of the seats in front with operable sliding, tilted windows opening to seating area. Care needs to be exercised in the design and location of the control room with respect to the campus and to an elevator. Ideally the control room would be close to an elevator and accessible from a second level to avoid a separate elevator just for the multi-purpose room.

Locate stage manager panels within the stage area, hidden from view of the audience, and in the control booth.

Provide a portable lighting control console to set up cues and lighting scenes. Provide control receptacles located near the center of the house and on the stage so that the lighting console can be moved to those areas if needed.

In addition to the control receptacles, 120V, 15 amp receptacles must be provided near the control receptacles.

Entrance stations to activate the house lighting, at the two entrances to the auditorium, must be wired to the control units in the dimmer racks.

The dimming system must be interlocked with the fire alarm system. In the event of a fire emergency, the house lights will come on at full brightness.

7.2.8 LIGHTING CONTROLS

Provide a Central Lighting Control System for all building and site lighting (see list of spaces below).

Beyond the interconnected control wiring within each wing or building, the control system shall interconnect within each Telecommunications Room with the site LAN and its structured cabling system. It shall then use the fiber-optic backbone cabling, with Ethernet and IT protocols, to communicate with the main LAN Room and then interconnect with the District Wide Area Network for central monitoring and control at the M&O Headquarters, as well as from any network-connected computer over the Internet.

The intent of these design criteria is to provide for an integrated communication and control system that communicates over the site LAN and its structured cabling system, utilizing the fiber-optic backbone for all between-building cabling, and provides integrating functionality with other District schools. It shall have the capability to integrate with other vendors' building management systems, such as HVAC controls.

Interconnection with safety and security systems shall be provided.

The manufacturer's representative shall oversee the installation of the complete system. Control system and equipment, including control sequences and provisions for future, shall be fully presented in the contract documents and specified in **Division 25, Integrated Automation** and/or **Division 26, Electrical (CSI Master Format 2004)**.

Interconnection with safety and security systems shall be provided.

Operator interface shall include site and building floor plans to show all alarm devices.

See also the ADM Sections, "Electrical Communications and AV Systems" and "HVAC Control Systems."

System & Manufacturer: **Lighting Control & Design (LC&D)**
(Repr. Michael Reyes, Lighting Control & Design, (323) 497-0001, 905 Allen Ave, Glendale, 91201, www.lightingcontrols.com)

or equivalent system by
Douglas Lighting Controls

7.2.8.1 Lighting-Controlled Spaces:

- All classrooms and instructional areas
- Corridor and Stair
- Library
- Locker Room
- Gymnasium
- Auditoria and Multipurpose Room
- Cafeteria/ Kitchen

- Shop, with controls similar to classrooms
- Restroom lights and exhaust fans (fans interlocked with lights)
- Main office, attendance office, and other offices. Where clerks are always present. provide non-locking local switching for manual operation. In addition, use light-intensity sensing units to reduce electric light levels in larger windowed offices and other areas where day lighting contribution is significant.
- Private offices and conference rooms. Provide also a wall-mounted occupancy sensor with automatic on-off switch as well as manual switches.
- Custodial, Equipment, and Unsupervised Rooms. Provide occupancy sensor with automatic on-off switch.
- Covered walks.
- Building perimeter, parking lot, and parking garage. (Inputs to perimeter and parking lot lighting shall have astronomic clock capabilities.)
- Provide local switches with pilot lights for attic lights, roof lights, and remotely controlled equipment.

Lock-type and vandal-resistant switches shall be provided for local manual operation.

7.2.8.2 Classroom Lighting Controls

Provide low voltage lighting controls for each classroom as prescribed in the SCE "Classroom Lighting Guidelines." Include the teaching wall switch and dimming or selective switching controls.

Provide dual technology occupancy sensors (infrared and passive sonic) with auto on-off capability.

Light fixtures shall have wall mounted bi-level switching (and dimming when used) for manual light reduction when delighting is adequate or for darkening of the room for AV presentations. Provide the switches adjacent to the classroom entrance door and at the teaching wall, easily accessible to the teacher.

Light fixtures within 15'-0" of windows shall be separately switched or dimmed and shall be controlled by a ceiling mounted daylight on-off photo sensor.

Corridor lighting shall be controlled by dual technology occupancy sensors. Emergency lighting in corridors shall be provided by a non-switched, normally off circuit from the central battery/inverter, controlling a separate ballast and lamp in selected light fixtures

Security Lighting shall be a separate zone of lighting control system. Use a separate lock type switch to control security lighting.

Lighting control equipment shall be locked, located, or otherwise made secure against vandalism.

7.2.9 LIGHTING POWER

Lighting branch circuits shall be 20 ampere, unless otherwise required by the system.

Provide a distributed balanced load on all phases for panels and branch circuits.

Lighting panel boards shall be 480/277 volt, 3 phase, 4 wire, with thermal magnetic branch circuit breakers. (Small sites may use 208/120 volt, 3 phase, and 4 wire panels.)

Provide approximately 30% spare capacity in all new panels.

The energy budget for all connected lighting loads in all buildings shall not exceed 9/10 of a watt per square foot (0.9 wsf).

7.2.10 LUMINAIRES

Selection of luminaires shall be made on the basis of lighting characteristics (including uniform distribution and glare), appearance, cost, maintainability, energy efficiency, and resistance to vandalism.

Each luminaire shall be fully specified and correlated with the Fixture Schedule. On the schedule, provide full data for each luminaire on lamps, ballasts, input wattage, and mounting type.

All installed luminaires shall meet the requirements of the CBC for seismic anchorage.

- Classrooms, Science and Technology Classrooms, Libraries: Linear Suspended Indirect or Indirect/Direct Fluorescent Luminaire. (See “Classroom Lighting Systems” for additional requirements.)
- Shops: Same as classrooms, or industrial surface mounted, or suspended open fluorescent luminaire if appropriate to the architectural design.
- Wallwasher (Whiteboard Light): Single-tube linear fluorescent luminaire, with characteristics described in “Classroom Lighting Systems.”
- Offices: Same as classrooms, or recessed 2’X4’ recessed troffer fluorescent luminaire.
- Teachers Workrooms: Same as classrooms, or recessed 2’ x 4’ recessed troffer fluorescent luminaire.
- Gymnasium: Suspended or ceiling mounted fluorescent troffer with protective cage and six T5HO lamps, switched in pairs. (Luminaires with alternative light sources will be considered.)
- Shower Rooms, Locker Rooms, Other Damp Locations: Fluorescent luminaire with acrylic lens, vandal resistant, with Ingress Prevention (IP) rating of 66.
- Multipurpose Room: Suspended indirect/direct fluorescent luminaire or recessed fluorescent luminaire with lens, as appropriate to architectural design.
- Auditorium House Lights: Fluorescent luminaire for general illumination, plus dimmable halogen house lights for performances.
- Corridors/Stairways: Wall or ceiling mounted fluorescent luminaire with polycarbonate lens.
- Lobbies: Wall or ceiling mounted fluorescent luminaire with polycarbonate lens.

- Student Restrooms: Fluorescent luminaire with polycarbonate lens, vandal resistant, with IP 66 rating.
- Equipment Rooms, Custodial Closets: Fluorescent luminaire, with occupancy sensor.
- Elevator Pits: Fluorescent luminaire with guard, and with IP 66 rating.
- Display Cases: LED strip lighting.
- Darkrooms: Darkroom lights.
- Hazardous Classified Areas (flammable liquids, others): Luminaire with suitable classification.
- Exterior Canopies, Arcades, Overhangs: Recessed or surface mounted fluorescent luminaire with polycarbonate lens, vandal resistant, with IP 66 rating.
- Lunch Shelter: Vandal proof recessed or surface mounted ceiling or wall mounted compact fluorescent luminaire with lens and two 13 watt twin tube lamps.
- Parking Garages: Ceiling mounted parking garage fluorescent luminaire with wire guard. Provide shields where necessary to avoid tubes from being seen from streets and adjacent properties. Indirect suspended up/down fixtures may also be used where vandalism is not an issue. Provide emergency and night lighting to selected fixtures per code requirements.
- Building Exterior: Surface mounted or recessed vandal resistant metal halide luminaire with polycarbonate lens. Select to eliminate bird perching. Mount above 10 feet wherever possible.
- Exterior Stair and Wall Lighting: Low mount step light fluorescent luminaire with clear tempered glass lens.
- Parking Areas: Pole mounted full cut off metal halide luminaire (maximum 30’ high poles).
- Swimming Pools: Recessed swimming pool luminaire.
- Exit Signs: LED “EXIT” sign.
- Low Level Exit Markers: LED low level exit marker sign.
- Sign Fixtures: Fluorescent sign.

7.3 ELECTRICAL POWER SYSTEMS

7.3.1 DESIGN PRINCIPLES

Basic design concerns include life safety, protection of property, reliability, voltage regulation, maintainability, and flexibility for future expansion (including changes in service voltage).

Preventive maintenance requirements must include accessibility and availability for inspection and repair with safety. Provide clean, well lighted, temperature controlled space with working spaces and access doors in front of all electrical equipment.

All electrical equipment and components shall be designed for exposure to the elements, or protected from them, including flooding.

All electrical equipment and components shall meet requirements for seismic anchorage and bracing.

7.3.2 ELECTRICAL SERVICE

The Architect shall consult and coordinate with the electric utility provider in requesting electrical service, and shall include in the contract documents the drawings and specifications provided by the utility. Requests must be made early in design, to allow sufficient time for obtaining utility engineer input.

Removal of utility poles and their guy wires may be necessary whenever new property is acquired. If poles serve other private properties then utilities must be rerouted. Coordinate the relocation of all utilities on the poles (power, telephone, cable television) and provide for the relocation of power poles from the school site as directed by the various utilities. Rerouting will be designed by the utility provider.

Provide a power metering panel that can be remotely monitored.

7.3.3 ELECTROMAGNETIC FIELDS

The design of new school facilities, and modernization projects must include measures to minimize the building occupants' exposure to high electromagnetic fields emitted by electrical equipment such as transformers, switchboards, panel boards, and building wiring. The following guidelines can help reduce electromagnetic field exposure and interference:

- Locate equipment in dedicated spaces that are not normally occupied: equipment rooms, storage rooms, and supply rooms.
- Locate large transformers, switchgear, and large panels remote from occupied spaces and on concrete floors. If outdoors or in parking structures, be sure they are isolated and secured with walls or fences and are well drained to prevent flooding.
- Locate equipment and equipment rooms so not to be immediately adjacent to, or directly above or below, classrooms, libraries, other instructional areas, office areas, and similar spaces.
- Do not route underground feeders beneath occupied spaces. Where underground feeder has to pass underneath the concrete slab to terminate at the distribution panel inside the building, install conduits a minimum of 24" below finished floor.
- Reduce current by using higher voltages where practical.
- Utilize balanced three-phase systems.

7.3.4 PLANNING CRITERIA

The preferred main power distribution system is 480/277 volt, 3 phase, 4 wire grounded WYE.

In very large campuses two 480/277 volt, 3 phase, 4 wire grounded WYE services may be installed if approved by the serving utility company

In very large campuses with the buildings very far apart, 5 KV medium voltage switchgear and power distribution may be used.

Provide 480-volt power for HVAC equipment and 277-volt for lighting.

All loads (in KVA) must be identified during design, such as lighting, HVAC equipment, kitchen equipment, shop equipment, computer equipment, and general receptacle load.

For preliminary system design, when the loads have not been identified, use the following loads for estimating purposes only.

General Spaces:	
Classrooms and Offices	3.0 VA/ft²
Cafeteria	2.0 VA/ft²
Multi-Purpose Room	6.0 VA/ft²
Kitchen	2.2 VA/ft²
Gymnasiums	2.5 VA/ft²
Toilets, Storage, Equipment	1.0 VA/ft²
Corridors	1.0 VA/ft²
Locker Rooms	1.0 VA/ft²
Laboratories	3.0 VA/ft²
Shops	3.0 VA/ft²
Air Conditioning:	
HVAC Refrigeration	Tons x 2.5 = KVA
Ventilation Fans	1.0 W/ft²
Small Appliance/Computer/General Purpose Receptacles:	
Cafeteria	1.0 VA/ft²
Gymnasiums	1.0 VA/ft²
Offices	5.0 VA/ft²
Classrooms	6.0 VA/ft²
Shops	6.0 VA/ft²
Food Preparation:	
Kitchen	20 VA/ft²
Cafeteria	10 VA/ft²
Shop Buildings (Machines)	20 VA/ft²

In existing facilities, the existing load may be assumed to be 125% (continuous load factor) times 125% (power factor adjustment) times the maximum KW demand obtained from the serving utility company.

7.3.5 DISTRIBUTION CONCEPT

For most schools, a radial distribution system is appropriate.

Depending on critical load requirements, other system types may be considered, such as primary selective or secondary selective.

The maximum voltage drop in each power feeder shall be no more than 3%, and the total drop including feeders and branch circuits shall be no more than 5% overall.

Show length and voltage drop percentages on single line diagram for all feeders.

Make short circuit calculations for all system components (with results indicated on the single-line diagram).

Design distribution system to minimize the generation of, and exposure to, magnetic fields. Appropriate magnetic field management techniques shall be considered for all new and retrofit installations.

Plan future system expansion during design. Do not design the system so that it is difficult or impossible to expand its capacity. Be sure future capacity is clearly identified on diagrams, plans, and in the narrative “Basis of Design.”

Spaces allocated must have room for future addition of electrical equipment.

For new campuses, allocate minimum 30% spare capacity over connected load to size main service equipment for future growth.

7.3.6 GROUNDING (CHECK WITH M & O ON THIS)

Cold water or other utility piping systems shall not be used as grounding electrodes, due to the use of insulating couplings and nonmetallic pipe in such installations. Grounding electrodes shall be “made” electrodes, either concrete enclosed electrode type (UFER) or ground-rod type.

UFER ground system shall be the primary grounding electrode for new campuses.

Ground rod(s) installed in concrete box(s) shall be the primary grounding electrode for existing campuses that do not have a UFER system.

All metallic objects that enclose electrical conductors or that might be energized by electrical currents, including all metal equipment parts such as enclosures, raceways, building metal structure, and equipment grounding conductors, must be effectively grounded. Together with all earth grounding electrodes, they must be solidly joined together into a continuous electrically conductive system connected to the main grounding system. Individual building grounding systems must be interconnected to a form a campus grounding system.

Provide “made” electrodes (as previously described in this section) at each individual building. The grounding systems of remote buildings must be interconnected to main campus grounding system thru the equipment grounding conductor(s) of the feeders

serving the remote buildings. Bond all enclosure and metallic objects to the building ground system (as described in preceding paragraph).

Bond the grounded conductor (neutral) of the main service and the secondary of all steps down transformer to the building ground system. The bonding of the neutral conductor to ground must ONLY BE DONE AT ONE LOCATION at each voltage level to avoid creating grounding loops.

7.3.7 CONDUCTORS

Select conductors based on the amp capacity tables in the California Electrical Code for low and medium voltage cables. Consider the temperature rating of the conductor, future load growth, voltage drop, short circuit heating, number of conductors within the raceway and ambient conditions.

All conductors and transformer wiring shall be copper.

Ambient temperature ratings for conductor selection are as follows:

- Indoors, within air conditioned spaces, 30° C ambient temperature may be used without temperature derating the conductor.
- Indoor areas, such as equipment rooms, where the ambient temperature will exceed 30° C, conductors must be derated to the worst possible ambient temperature condition.
- Outdoors, for low voltage conductors in metallic raceways in the shade, use a derating factor for an ambient temperature of 45° C; in the sun, use a derating factor for an ambient temperature of 50° C.

For Medium Voltage Power Distribution (above 2000 volt) underground applications, the ambient temperature used for conductors within a raceway shall be 30° C. This means the appropriate amp capacity from the tables in the California Electrical code must be derated to this temperature. The thermal characteristics of the medium surrounding the conductors are important to determine the current carrying capacity of the conductors. Factors that will affect the current carrying capacity of the conductor include the following:

- The type of soil in which the duct bank is buried and its thermal receptivity.
- The moisture content of the soil. In dry sections, the conductors must be derated to compensate for the increase in thermal resistance that is due to the lack of moisture.
- The type and number of raceways and number of conductors per raceway within an overall concrete duct bank.

Derating of the conductors may be necessary under high fault currents. Thermal and mechanical stresses can result in permanent damage to the insulation and undesirable cable movement. The minimum conductor size requirement shall be determined based on the maximum available short-circuit current and the type of over-current protective device used.

Exterior underground conduit shall have 24-inch covering, with a minimum of 95% compaction.

Power wiring shall be copper and in conduit. Transformers shall have copper windings.

Provide oversized neutral for computer rooms with multiple circuits.

7.3.8 CONDUIT

Install conductors in metallic conduit above ground and in schedule 40 PVC underground, and comply with the following additional requirements. Cover underground conduit for 480V and above with slurry ("Edison mix").

Use rigid steel conduit at all exposed locations and where conduit may be subjected to damage or water intrusion, including all exposed locations in parking garages. Flexible non-metallic conduct (NMC) may be used in concrete slabs of parking structures if adequate cover is provided, subject to approval of all agencies having jurisdiction including DSA (if applicable).

Use EMT only indoors and where concealed.

Use flexible steel conduit only indoors and where concealed.

Use liquid tight flexible steel conduit for final connections to motors.

Do not install exposed conduit on roofs or beneath eaves or covered walks.

Conceal all conduit except in equipment rooms, garages and otherwise unoccupied spaces without furring or other concealment opportunities.

Use steel fittings -- no die-cast or set screws.

Underground conduits must be encased in concrete 3" thick on all sides with multiple conduits spaced not less than 7 1/2" on centers and 1 ½" apart. Bury conduit banks not less than 24" below finished grade to top of the concrete envelope. Trenches shall be backfilled to 95% compaction.

Provide steel conduit 90 sweeps on underground raceways (horizontal or vertical).

7.4 DISTRIBUTION EQUIPMENT

In selecting distribution equipment, electrical ratings must have adequate capacity to serve the connected load.

Equipment short circuit ratings must be selected to withstand the maximum fault current at the equipment terminals or busses.

Locate all power equipment and panels in electrical equipment rooms that are completely separate from signal and communication equipment. Provide at least one electrical equipment room in each building. Rooms shall be air-conditioned and of one-hour fire-resistive construction minimum where required by applicable codes.

Review physical dimensions of the equipment to determine adequate space allocation requirements to serve connected loads and future expansion. Provide working clearances around the equipment to comply with code and working requirements.

Consider and plan to mitigate appropriately environmental conditions surrounding the equipment. Adequate ventilation must be provided in all cases. Locate central battery/inverter systems in an air conditioned rooms.

Calculate and submit the heat load created by the electrical equipment to the mechanical engineer to properly size HVAC equipment serving the electrical rooms.

Provide infrastructure for electric utility facilities including transformer pad, underground vaults, customer stations, pull sections and metering compartments in main switchboard, underground conduits, pull boxes and grounding, as required by electric utility.

Switchgear panel must be fully bussed and must be expandable above the bus bar.

All equipment must be secured from unauthorized access and from vandalism, and must be protected from harmful environmental conditions, including flooding.

Manufacturer: Square D or GE.

7.4.1 CAPACITY CRITERIA

New main and distribution switchboards, panel boards and motor control centers shall have minimum 30% spare capacity above connected load and physical spaces for additional protective devices to be added in future.

New panel boards shall have 30% spare capacity above connected load.

7.4.2 CIRCUIT PROTECTION AND MOTOR CONTROLS

All switchboards, motor control centers, and power panel boards shall include a main circuit protective device.

Provide a heavy duty fused disconnect switch at all HVAC units, including heat pumps, condensing units, chillers, package units, etc. It is not required if HVAC equipment is furnished with an internal circuit breaker or fused switch.

Provide combination fused switch starters for all pump motors, fan motors, cooling towers, and dust collectors. Provide a control circuit transformer with 120 volt secondary, handoff auto selector switch and on-off indicating lights in each starter.

Provide control wiring and interlocking for operation of motor loads, as required by each motor circuit.

All load centers shall have “bolt-on” circuit breakers.

7.4.3 GENERAL PURPOSE RECEPTACLES AND CIRCUITS

All receptacles shall be wall mounted at 18” above floor level unless otherwise indicated for specific purposes.

Do not use floor receptacles except as follows or where expressly approved in writing by the District. Where used, they shall be recessed. Special locations might include receptacles for projectors or charge carts.

Do not locate receptacles behind appliances or other equipment that must be served.

Corridors: At intervals of 50' maximum, switched with a lock type switch, preferably in a custodial closet or work room.

Building exterior walls: Weatherproof GFI receptacles on each wall within a lockable box or cabinet, and switched with a lock type switch in a custodial closet or workroom. Do not provide receptacles in Kindergarten play areas.

Restrooms: One only 20 amp GFI receptacle in each restroom, switched with a lock type switch in a custodial closet or work room.

Equipment Rooms: One minimum.

Science Classrooms: General purpose duplex receptacles (computer receptacles and circuits are already separate) every 6 feet over the counter on the wall on a separate 20 amp branch circuit per counter. Use GFI receptacle within 6 feet of sink(s).

Auditorium/Multipurpose Room: On walls spaced at 20 feet on center maximum.

Gymnasium: 8 minimum, 2 in each wall minimum.

Music Instrumental and Choral Rooms: On walls same as classrooms.

In Photographic Darkrooms: Separate circuits for special darkroom lights and for room lights, with room lights on a lock type switch.

Cafeteria Window Service Area, Scramble Area, and Faculty Service Area: One minimum.

Within 72 inches of a sink or in any similar conditions (such as custodial closets), use GFI receptacles.

Manufacturer: Switches, receptacles: Hubbell.

7.4.4 RECEPTACLES IN CLASSROOMS

Provide a separate branch circuit for general purpose duplex receptacles in each classroom, with a minimum of five general-purpose duplex receptacles in each classroom, one in each wall and one at the teacher desk location.

Provide separate receptacles or connections on a separate circuit for other electrical equipment.

Do not use floor outlets or wire mold, except as authorized herein, without approval in writing from the District.

Do not locate receptacles or switches in bulletin boards, tack boards, or marker boards unless boards extend to top of base (where used as wall covering).

7.4.5 SPECIAL PURPOSE RECEPTACLES AND SEPARATE CIRCUITS

Provide dedicated 220 VAC circuits and receptacles (unless advised otherwise in writing by the District) as follows:

∞ Copier equipment in staff/faculty work rooms.

- Gymnasium scoreboards. Provide for remotely controlling scoreboards from side lines with 1/2" empty conduit from scoreboards to floor boxes located 5'-0" out from sidelines near midcourt.
- Domestic cooking electric ranges (for gas ranges provide 120 volt circuit for ignition).
- Science Classrooms exhaust fume hoods.
- Science Preparation/Storage Room refrigerator and freezer.
- Industrial Education Classrooms and Shops: Conduit drops from overhead wire ways to a receptacle at each workbench and to each electrically driven machine.
- First Aid Room refrigerator and cook top, as well as a 120v receptacle and switch for eye chart.
- DH (define) Storage and Laundry Room washer and dryer.
- Special Education Therapy Unit refrigerator and cook top.
- Kitchen equipment and exhaust hoods. All electrical equipment under kitchen hoods shall be automatically disconnected upon activation of the fire suppression systems.
- Provide a separate branch circuit for the fire suppression Ansul System installed in kitchen hoods. If Ansul System is activated, power to all electrical appliances under kitchen hood shall be automatically disconnected. Appliance circuits shall be wired through shunt trip circuit breakers or contactors that are interlocked with the Ansul System.
- Automatic lawn sprinkler controllers: 1 each as shown by the Landscape Architect.
- Electric drinking fountains: 1 each.
- Rooftop: Provide 120v outlet on each HVAC unit and adjacent to any other rooftop equipment that might need servicing or repair.
- All other appliances and special equipment where necessary.

See ADM Section Electrical Communications and AV Systems for power provisions for computer systems.

EMERGENCY POWER SYSTEMS

7.4.6 GENERAL

Emergency power systems must be part of the design of the electrical system for egress illumination and signage, fire alarm, security, public address and telephone systems, and computer networking system, and must provide continuity of operation for specifically identified systems or equipment.

Provide emergency exit illumination of one (1) foot-candle-minimum in the following areas:

- Corridors, stairs, lobbies, and exterior paths of travel
- Classrooms

- Multipurpose/Auditorium buildings
- Gymnasiums
- Cafeteria/Kitchen
- Administration unit
- Any rooms with an occupant load of 50 or more
- Parking Structure designated exit pathways
- Other occupancies required by code

Exit signs connected to the emergency power system shall be provided as required by code, except low level exit signs shall be self-luminous type.

7.4.7 EMERGENCY SYSTEMS REQUIREMENTS

For emergency lighting and exit illumination, in each building provide a central inverter system consisting of AC sensing equipment, automatic transfer switch, battery charger, batteries and DC to AC inverter to provide a minimum of 90 minutes continuous emergency operation. (Evaluate the alternative of using an emergency generator system for individual sites.)

For communications and computer networking systems, see ADM Section, “Electrical Communication and AV Systems,” for UPS system requirements.

7.4.8 EMERGENCY GENERATOR SYSTEM

An emergency generator system is required in multistory buildings higher than 75-feet in height. In such cases:

- Eliminate central batter/inverters and use the generator for emergency lighting.
- Provide emergency power for all elevator cab lighting and power for selected elevator(s).
- Provide emergency power for subterranean sump pumps (garage areas).
- Provide emergency power for all signal head-end equipment.
- Power emergency power for fire/ life safety systems such as fire pumps and other systems as required by codes.
- UPS systems as described in previous paragraphs for various systems will still be required.

Manufacturer: Diesel generators by Kohler.

8. ELECTRICAL COMMUNICATION AND AV SYSTEMS

8.1 GENERAL REQUIREMENTS

A goal of these design criteria is to reduce capital costs and improve operational efficiencies of all building communications, control and alarm systems, by achieving:

- ∞ Maximum feasible integration and interoperability of communication/control systems
- ∞ Communication over the site LAN and its structured cabling and fiber-optic backbone system
- ∞ Utilizing Ethernet and IT protocols, and Internet access to system information and interaction
- ∞ Use, so far as practical, of open protocols like BACnet and OnSSYS
- ∞ Support of systems and components from multiple vendors, to provide competitive pricing and to provide maximum flexibility for future upgrading or enhancement

This goal applies to all systems including the computer data network; telephone, intercom, paging, PA, clock management, fire alarm, intrusion detection alarm; door access control; video camera surveillance; TV distribution; and building automation systems (BAS) including HVAC (DDC), lighting controls, as well as future additions such as water management and irrigation.

All low-voltage communications wiring shall be continuous without splices between devices, and shall be in raceways -- conduit or cable trays -- except for local distribution above ceilings within classrooms and other small areas where they may be organized and suspended in approved hangers, and only above ceilings.

See also the sub-section below, “Signal Systems Raceways & Terminal Cabinets.”

Conduits and cable trays shall be metallic, except in exterior underground applications where PVC conduits are encased in concrete. Interior under slab areas may have PVC conduit.

All panels and control equipment must be accessible from floor level, without the need for ladders or other access equipment.

In addition to this section, refer also to ADM Sections on “HVAC (Controls Systems)” and “Electrical Power and Lighting (Lighting Controls).”

Systems and equipment, including control sequences and provisions for future, shall be fully presented in the contract documents. The work described in this section shall be specified in Division **27, Communications**, and Division **28, Electronic Safety and Security**, in accord with CSI Masterformat, 2004 Edition.

8.2 FIRE ALARM SYSTEM

Fire alarm system shall be an automatic local fire protective signaling system with functionality for central station reporting, with electrically supervised signal initiating circuits and alarm circuits, including control panel(s), remote power supplies, remote

annunciator panel, manual pull stations, bells or horns, visual alarm units, sprinkler flow and tamper switches, smoke detectors, heat detectors, beam detectors, terminal cabinets and wiring.

All fire alarm cabling shall be in conduit.

For purposes of management effectiveness, monitoring efficiency, and maintenance standardization and economy, the District has selected a single combined fire-alarm, intrusion-detection-alarm, and door-access-control system, that has been approved by DSA and CSFM. It shall be specified **in Division 28, Electronic Safety and Security,** of CSI Master Format, 2004 Edition.

System shall be IP and Web-based so monitoring and control can be done over any network-connected computer in the District's wide-area network. Operator interface shall include site and building floor plans to show all alarm devices.

System & Manufacturer: **EST3 "Synergy" with "Fireworks," by GE Security (formerly Edwards Systems Technology)** or approved equal.
(Repr. Drew Turner, GE Security, 909-629-1827; and ENKO Systems, Dan Cox, San B'do, 909-885-7771)

8.2.1 GENERAL

The following information has been written for a stand-alone fire-alarm system. Utilize the functionality as appropriate for the combined fire and security alarm system.

Typically, for Elementary Schools, one control panel will be adequate for the entire site. The control panel shall be expandable to ten loops. Each loop shall be able to handle up to 125 intelligent detectors and 125 monitor and relay modules. A 20% spare must be allowed for future use.

Where the capacity of the control panel (including spare capacity) will be exceeded, provide additional panels, connected in a network configuration as one.

Fire alarm systems shall comply with NFPA, DSA fire and life safety requirements, and Education Code, and be UL and CSFM listed, power limited, battery backed, electrically supervised systems.

Fire alarm system shall be an addressable system with closed loop monitoring of each initiating device.

The fire alarm system shall be interfaced with program controller and PA system to deactivate program/classroom change devices during a fire alarm condition. All manual and automatic program signals shall be deactivated during a fire alarm condition.

Provide a 120 volt, 20 amps, dedicated circuit and terminate in each of the following cabinets: main fire alarm control panel(s), transponder(s), and remote power supply(ies). Circuit breaker at panel board shall be equipped with a handle lock on device. Provide surge suppressor at input of control panel.

Provide a permanent label in all fire alarm panel(s), transponder(s), or remote power supply(ies) indicating the electrical panel and circuit designation as well as a description

of the physical location of the electrical panel. All labels shall be affixed to the inside of the panel door.

A remote annunciator panel with LCD Display shall be provided in the Administration Building main office where it is accessible by office personnel only.

When adding new fire alarms to an existing campus where the old system can not be extended, provide a new controller in place of the existing controller, to supervise existing control relays or wiring and to control existing fire alarm bell relays. Provide a new annunciator in the main office controlled by the new controller.

8.2.2 INITIATING DEVICES

Provide smoke detectors in every room. Smoke detectors shall be the primary means of automatic alarm initiation. Heat detectors may be used in those spaces where a smoke detector would not be suitable.

Do not provide smoke detectors in areas that are exposed to the weather.

Install heat detectors above suspended ceilings of every room and in accessible attics only where required by code. (See 1999 NFPA 72 2-1.4.2.1 for definition of "accessible attic" and codes for proper design.)

Non-accessible attics that contain combustible materials shall be made accessible and be protected by heat detector(s) if required by code.

A label indicating the location of heat detectors above suspended ceilings shall be provided and affixed to the ceiling T-bar frame. The label shall have the words "HEAT DETECTOR" in red on a white background. Heat detectors above a "hard lid" ceiling shall have an access hatch for each concealed heat detector and the hatch shall have a "HEAT DETECTOR" label affixed to it.

Design and installation of automatic fire detectors shall conform to NFPA 72 and ADAAG.

Provide smoke detectors at each interior elevator lobby and elevator machine room. Smoke detectors are used to recall elevator cars to preassigned floor levels and to initiate a general alarm. Each elevator lobby smoke detector must report as one address to the fire alarm system. Elevator lobby smoke detectors are not required if elevator total travel distance does not exceed 25'0" or if elevator door opens to unenclosed landings that are open to the atmosphere or open to an interior court of a building. A machine room smoke detector is always required.

A rate of rise/fixed temperature heat detector shall be provided in the elevator machine room and be installed within 2' of the sprinkler head to shut off power to elevator equipment. Provide an addressable relay module to interface with shunt trip circuit breaker providing power to elevator equipment. By activation of heat detector, power to elevator equipment shall be shut down. The activation temperature of the heat detector shall be lower than that of the sprinkler head. A smoke detector in the machine room for elevator recall is recommended.

Per elevator code requirement, when there is a fire sprinkler installed at the top of an elevator shaft, a smoke and/or heat detector is required at the top of the elevator shaft.

If there is no fire sprinkler at the top of the shaft, then a heat detector is required. An external hatch must be provided to safely access the detector(s) and a UL approved cage must be provided. Activating this device shall recall the elevator and cause a general alarm. If a sprinkler head exists at the top of the shaft, a detector must shut down the elevator power. A smoke detector is always recommended for elevator recall whenever possible when a heat detector is present for shunt trip service.

In the sequence of operation chart, clearly indicate the alarm/recall/ power shut down requirements. All fire alarm detectors report to the fire alarm system. The fire alarm system reports to the elevator controller.

If combination smoke/fire dampers or duct smoke detectors are required, this work shall be part of the fire alarm system and all components and wiring shall be indicated on electrical drawings. Smoke detectors may be used in lieu of duct detectors to shut down HVAC systems or to control combination smoke/fire dampers if ALL areas served by the HVAC system are protected with smoke detectors. The fire alarm system shall be programmed to shut down the HVAC system or close the smoke/fire damper if one or more of the area smoke detectors are activated. All detectors must be accessible for yearly testing. Provide addressable relay modules to interface with HVAC or smoke/fire damper controls in order to shut down the HVAC unit or close the smoke damper. **Coordinate this work with that of the HVAC system to avoid duplication of systems.**

Provide monitored flow and tamper switches at each sprinkler riser assembly. Flow and tamper switches shall be addressed individually per building and per floor level. Provide a separately addressed tamper switch at each post indicating valve (PIV).

Provide outdoor bell for each sprinkler riser controlled and supervised by the fire alarm system if required by code.

Since automatic initiating devices are provided in all rooms and attics as part of the fire alarm system, do not provide pull stations, except in areas specifically required by code. Areas where manual pull stations are typically required include assembly areas such as gymnasia, auditoria, kitchen/dining areas used for assembly, and multipurpose rooms. Install one manual pull station within 5’ of each exit door in these spaces.

Provide one manual pull station within 5’ of the fire alarm annunciator in the main office of the administrative unit.

All manual pull stations, except the manual pull station in the office by the FA annunciator, shall be provided with a protective cover.

Connect automatically activated dry chemical fire extinguishing system provided in a prefabricated kitchen hood to fire alarm control panel as a separate fire alarm zone. Impose a 45-second delay on audible and visible circuits. Provide fire and trouble indication at annunciator panel.

Provide protective covers for pull stations, smoke/heat detectors, audible and visual devices located in areas that can be subject to vandalism such as gyms, student restrooms, locker and shower rooms, and all hallways and corridors associated with these spaces.

No manual pull stations, fire bell controls, electric panel boards, fire extinguishers or hose cabinets are to be located in student restrooms.

8.2.3 ALARM (INDICATING) DEVICES

Provide sufficient alarm sounding device coverage for entire plant including interior and yard areas. Avoid exterior of school site except near entrances to buildings to minimize disturbance of neighborhood.

Alarm sounding devices at each school site shall be the same type, either horns or bells. All audible alarm signals shall be synchronized within the zone in which they are located. For new plant construction, horns shall be used as alarm sounding device. At existing school sites, bells are normally used.

Alarm sounding devices shall be capable of sounding alarm at a level of 15 decibels above ambient noise or 75 decibel minimum, whichever is higher; measured 4' above floor.

Provide combination horn strobes in classrooms.

A 60 second silence inhibit shall be imposed on audible and visual alarm circuits to insure that the building occupants perceive any alarm. There shall be an audible and visual fire and trouble indication at annunciator panel.

Provide visual alarm devices in classrooms, toilets, rooms with high ambient noise, special education rooms such as classrooms for deaf and hard of hearing, dining areas, locker rooms, shower rooms, gymnasia, auditoria, assembly areas, corridors and hallways, public areas of main office, band and music rooms, shops, and any room where ambient noise exceeds 105 decibels. Visual alarm appliances where more than 2 are visible or flashes from more than 2 appliances are visible shall be synchronized.

Install bells and horns a minimum of 8'0" above finished floor. Visual appliances shall be mounted 8'0" above the finished floor to the bottom of the lens or 6" below the ceiling, whichever is lower.

Provide magnetic door holders with addressable relay modules to close normally open fire doors upon detection of smoke in the area of the door.

8.2.4 ZONING, PANELS AND WIRING

In addressable systems, each initiating device shall be one point (or zone) in the system that is individually annunciated. For example, smoke detector in Building B, Classroom No. 213, shall be considered as one point (or zone).

Provide the following note on drawings: "The fire alarm system shall pass tests required by the local fire departments."

Provide WAN connection hardware in FACP for connection to the District WAN for communication to the existing Fireworks central monitoring station located at the District School Police Headquarters, for 24-hour monitoring of each individual addressable point in the Fire Alarm System.

Provide at least one terminal cabinet inside each building for termination of all fire alarm system wiring, typically in the Telecommunications Room. Buildings with a walkway or

arcade that divides footings of the buildings shall have a terminal cabinet in each of the buildings.

A fire alarm system control panel and main fire alarm terminal cabinet shall be located in the main LAN Room. An annunciator panel shall be located in main office clerical area away from public access, provided with an integral keyed locking switch to disable/enable the annunciator controls. Do not locate fire alarm control panel in mechanical or electrical equipment rooms.

8.2.5 CONSTRUCTION DOCUMENTATION REQUIREMENTS

Construction Drawings shall include the following information at a minimum:

- Complete sequence of operations.
- Required power connections for all control panels and remote power supplies.
- Mounting details for horn, strobes, pull stations, panels, etc.
- Wiring diagrams for smoke detectors, heat detectors, pull stations, audible and visual devices duct smoke detectors, projected beam detectors.
- Coordinate with duct smoke detectors provided as part of the HVAC system. Show HVAC system shut down provisions wherever required.
- At existing schools, disconnection and removal of existing fire alarm components.
- Interim housing fire alarm system interconnection requirements including temporary relocation of office areas to portables or other areas of permanent construction such as libraries.

8.3 COMPUTER NETWORKING & STRUCTURED CABLING SYSTEMS

8.3.1 GENERAL

A complete Local Area Network (LAN) and Computer Network System shall be provided for all new school projects and new building additions.

A structured cabling system (SCS) shall be designed that provides integrated end-to-end connectivity solutions (from a single manufacturer and including 25-year warranty) for data, voice, security, video and building automation applications in both wired and wireless enterprise networks.

Preferred Manufacturer: CommScope/SYSTIMAX Structured Cabling Solutions or approved equal

Electrical power with surge protection and filtration must be provided for all computer equipment.

Refer also to the District's "Guide Specification" for "Structured Cabling System."(verify with IT we have such a document)

The Architect shall consult with the District prior to design of system to determine specific project related requirements, including owner-furnished network equipment.

8.3.2 LOCAL AREA NETWORK (LAN) AND STRUCTURED CABLING SYSTEM

The structured cabling system (SCS) shall extend from the telecommunications trunk entrance to the Main Distribution Frame (MDF) in the main data center, or **LAN Room**, to the Intermediate Distribution Frames (IDF) in wiring closets, or **Telecommunications Rooms (TR)**, to the work area station connection points, or **Telecommunications Outlets (TO).** It is Ethernet-based, and serves to integrate all the data, voice, video, security and BAS communications under one structured cabling infrastructure (with separate but interconnected cabling for fire alarms). It shall consist of fiber-optic backbone cabling to IDF's, and copper horizontal cabling to TO's.

Backbone cabling shall provide interconnections between entrance facilities, the MDF, and IDF's. It consists of the transmission media, intermediate and main cross connects, and mechanical terminations. The backbone cabling shall use the star topology where each IDF is wired to a main cross connect.

There shall be no more than 2 levels of cross connects in the backbone wiring.

Backbone transmission media shall be fiber-optic cable consisting of 12 fiber strands of 50/125 um multimode fiber, and 6 fiber strands of single-mode graded index optical fiber cable, as follows:

- One cable dedicated to the computer data and to voice communications (including telephone, intercom, PA and clock)
- One cable dedicated to other building management and security systems

Each switch in each IDF shall have a dedicated uplink fiber pair connected to the MDF switch. When all switches have been connected, there shall be 50% spare (dark) fiber.

> (As an example, if an IDF has 5 (24) port switches, the uplinks required will use 10 strands (5 pairs) of multi-mode fiber. Using a 12mm/6sm fiber would only leave 2 spare strands, in order to comply with the 50% spare requirement, the backbone mm fiber count must be increased to an 18mm/6sm cable. This allows 8 spare mm strands, which is in compliance with the 50% spare requirement. An 18/6 cable will meet the uplink requirements for a maximum of 6 switches (12 strands) with 6 strands (50% spare) reserved for future expansion.)

Horizontal cabling extends from the IDF in the Telecommunication Room (TR) to each Telecommunications Outlet (TO) in the work areas. Horizontal cabling includes the TO, the physical termination for the cables, and the patch panels and/or data switches located in the IDF. Horizontal cabling shall use the star topology where each TO is connected to an IDF. The horizontal distance from the termination in the TR to the TO must not be greater than 90 meters (295').

Horizontal cabling shall be or consist of

- Computer data network: Category 6, 100 ohm, 4-pair unshielded twisted pair cable, plus a 4 strand multi-mode fiber cable to each teacher workstation or Limited Distribution Cabinet (LDC) as directed by the District.
- Other building systems: Comply with the system manufacturer's cabling requirements as a minimum. Where practicable, use Cat 5e cable for future conversion to IP signals.

LAN equipment shall be designed to incorporate no more than 20 outlets wired to a 24 port switch. This requirement shall be in addition to any planned growth factors for future wiring requirements.

LAN Room must be located in the Administrative Offices and dedicated to computer and communications equipment (no power panels).

Telecommunications Rooms (TR) must be centrally located to the areas served, and near a building face that minimizes exterior site cabling. It shall have access directly to a public way, and shall contain only telecommunications wiring and equipment (no power or mechanical equipment). Each room must contain the terminations and devices for the horizontal wiring system. The room must have sufficient space to accommodate all the components and servicing space. A typical TR can have the following components:

- Rack (19") for mounting equipment, patch panels, and switches.
- Raceways for routing cables to TO's.
- Raceways/cable tray for routing backbone cabling.
- Rack-mounted uninterruptible power supply (UPS) for active components in IDF racks. UPS devices shall be located at the bottom of the rack space.

Cabling, raceways and related cabling equipment, including cable supports and wire management equipment, cabinets, racks, patch panels and patch cables are considered part of the structured cabling system, and shall be Contractor-Furnished, Contractor-Installed **(CFCI)**.

Computer network equipment -- file servers, network switches, routers and UPS units -- shall be Owner-Furnished, Contractor-Installed **(OFCI**).

All MDF and IDF racks shall have 50% physical space for future expansion. Provide rack elevation details showing all owner and contractor furnished components.

Other signal head-end equipment shall be located in the LAN Room.

Other communication signal systems shall also share the TR's with LAN IDF equipment.

LAN Room and all IDF rooms (TR's) shall be built of 1-hour fire-resistive construction where required by code, and shall be air conditioned 24 hours a day, 365 days a year, with a dedicated unitary system (usually roof-top). **Coordinate with Mechanical Engineer.**

8.3.3 TELECOMMUNICATIONS OUTLETS (TO)

General: Avoid the use of floor mounted data outlets; use wall mounted outlets. In computer labs, use 5400 Wire Mold unless otherwise approved by the District in writing.

General, Arts, Science and Shop Classrooms: Provide minimum of Category 6A drops, 6 for students and 1 for teacher, plus one four-strand fiber drop at teacher's location. Locate student drops to suit design, or on two or three walls for students (other than the instructional wall) in secondary schools, and on one wall for elementary schools, not on a wall opposite windows (to reduce veiling reflections on screens).

Computer Laboratories, Technology Centers, Multi-Media Centers, Business Classrooms: Provide Category 6 drops to serve all work stations, and 1 for teacher, plus one four-strand fiber drop at teacher's location. Locate student drops to suit design. Typically group jacks in Computer Labs, which typically may have 40 drops, with up to 6 jacks per faceplate. (If necessary, provide a Local Data Frame (LDF) in these rooms, served by a minimum four-strand fiber drop.) Explore also the use of wireless access points for these rooms.

Administrative Units: Provide 3 Category 6 drops at each workstation. Terminate each group of 3 drops in a single four-position faceplate with 2 jacks indicated for Data and 1 for Voice.

Conference Rooms: Provide up to 8 Category 6 drops; 4 each at 2 separate locations (faceplates) in the room. Terminate each group of 4 drops in a single faceplate with 2 jacks indicated for Data and 2 for Voice.

Library: Provide a Category 6 data drop to each workstation as well as those listed below. (If necessary, provide a Local Data Frame (LDF) in these rooms, served by a minimum four-strand fiber drop.) Group drops with 2 Category 6 jacks and 2 blank jacks per faceplate. Close empty openings on faceplates using factory made blank inserts.

- Circulation desks: Provide 4 data drops.
- Library Offices: Provide 2 data drops.
- Primary Center Libraries: Provide 6 student data drops in addition to the circulation drops.
- Elementary and secondary school sites: Provide a minimum of 12 and a maximum of 40 total library drops in addition to the circulation desk and library office data drops. The designer shall base the student drop counts above 12 on a 6:1 ratio as applied to the maximum occupant load capacity of the room.

  As an example, if a library has an occupant capacity of 80, the drop count will be 13 (13.3333 rounded down).

Student Nutritional Support Areas: Provide up to 20 Category 6 data drops distributed from the IDF. (If necessary, provide a Local Data Frame (LDF) in these rooms, served by a minimum four-strand fiber drop.) Group Category 6 drops with 2 Category 6 jacks (and 2 blank jacks) per faceplate. Close empty openings on faceplates using factory made blank inserts. Distribute drops within the room according to design locations of workstations or other user requirements..

Student Nutritional Support Areas (Exterior Locations): Provide 2 Category 6 drops in an environmentally sealed enclosure.

Multipurpose Rooms: Provide a total of: 8 Category 6 data drops and 1 four-strand fiber drop distributed from the closest IDF location. Group drops with 2 Category 6 jacks per faceplate. Close empty openings on faceplates shall be with factory-made blank inserts.

- Multipurpose Room Stage Area: Provide 2 Category 6 drops and (1) four-strand, multimode fiber to an outlet at either the stage apron or the proscenium arch.

∞ Multipurpose Room (other three walls): Provide 2 Category 6 data drops on each wall (one per wall).

Other Non-Instructional Work Areas: Provide additional work area horizontal fiber and Category 6 cabling requirements as determined by the project design.

8.3.4 POWER REQUIREMENTS

Provide an electronic grade panel board to supply power for all computers at each floor or wing. The panel board can be either supplied from a general purpose panel board, which is fed from a K4 rated transformer, or from a dedicated K4 transformer.

A duplex receptacle shall be mounted in wall near location of each computer workstation. A double duplex receptacle shall serve 2 workstations where installed side by side. A 120 volt, 20 amp circuits shall be provided to serve up to maximum 3 workstations. Provide a dedicated 120 volt, 20 amp circuit and receptacle for each network or stand alone printer from electronic grade panel board.

For each branch circuit serving computers, use a dedicated neutral.

All receptacles for computers shall be standard type, except blue in color.

In MDF and IDF rooms or areas, the number and type of electrical outlets will depend upon and must be designed to the specific size, type of equipment, and UPS equipment required.

∞ Minimum of 1 dedicated, 120 volt, 20 ampere circuit and a rack mounted receptacle outlet of the same rating is required at each IDF for the rack-mounted UPS system.

∞ Dedicated 208 volt, 1 phase, 30 ampere circuit terminated in a NEM L6-30P rack mounted receptacle is required at each MDF for the rack mounted UPS system.

8.3.5 UNINTERRUPTIBLE POWER SUPPLY (UPS)

Power to LAN equipment must be fed from an uninterruptible power system that provides protection against brownouts, sags, surges, noise harmonics and blackouts. A rack mounted UPS shall be provided at each MDF and IDF (Owner-Furnished, Contractor-Installed **(OFCI**)).

The UPS shall support the continued operation of the LAN equipment connected to the MDF for a period of 1 hour after the loss of power service.

The MDF rack mounted UPS shall include hardware and software to be capable of initiating a safe system shutdown by a server.

The rack mounted UPS shall support the continued operation of the LAN equipment connected within the IDF cabinet for a period of thirty minutes after the loss of power service.

8.4 INTEGRATED COMMUNICATION SYSTEM

It is the intent of these criteria to provide an Integrated Communication System (ICS) to integrate the functions of intercom, paging, public address (PA), and clock. This system will either interconnect with the telephone system (PBX) for outside calls, or will be

integrated with a Voice over Internet Protocol (VoIP) exchange if that system is selected for a specific school.

Occupancy (Motion) Sensors shall not be included with this system, since they are provided as components of the Lighting Control and Security Systems (see lighting controls in the section on "Electrical Power and Lighting").

System Manufacturer:

Rauland-Borg Telecenter VI (with Voice over IP Communications)
(Mfctr. Hank.Plaiser@rauland.com
Phone: 602-625-6727
(Repr.: Thompson Engineering Co. Riverside, Richard Erskine, Dennis Martinez, 909-208-9206)

or equivalent system by

Bogen Systems Multicomm 2000
(Repr: Time and Alarm Systems, Mira Loma, Gary Maret, 951-685-1761)

Dukane Systems by GE Security
(formerly Edwards Technology Systems)
(Repr. ENKO Systems, Dan Cox, Brian Myers, San B'do, 909-885-7771)

The following sections describe the functions of separate systems. These shall be integrated into the Telecenter VI system as appropriate.

8.5 TELEPHONE PBX SYSTEMS

8.5.1 GENERAL

Provide a PBX telephone system that is integrated with the public address (PA), intercom, clock, and class/program change signaling systems described in this section.

Provisions shall be made for future VoIP functionality. If the District chooses for a specific project to use a Voice over IP (VoIP) telephone system, apply the following criteria as appropriate (also see the following paragraph on "PBX General Requirements").

The Architect Engineer shall consult and coordinate with the telephone utility provider in requesting service, and shall include in the contract documents the drawings and specifications or other requirements provided by the utility. Requests must be made early in design, to allow sufficient time for obtaining utility engineer input.

PBX systems, depending upon the size of the project to be served, require either floor space or wall mounting space. PBX systems shall be contained within a system cabinet. Access and egress, especially at the front, rear and sides of the main control cabinet, must be determined and planned to provide adequate space for operation and service.

Provide dedicated telephone line connections needed for elevators, for fire alarm and intrusion-alarm systems.

PBX equipment shall consist of following components:

- Main, free standing control cabinet or wall mounted control unit
- Bay control cards in control cabinet
- Bay power supplies in control cabinet
- Trunk cards in control cabinet
- Station cards in control cabinet
- Disk drive in control cabinet
- Other components as determined by specific project requirements

8.5.2 ELEMENTARY SCHOOLS

System shall consist of a PBX telephone system and telephone lines with connections to other systems (i.e., intercom, public address and class/program change signaling system).

The following telephone lines are required for Elementary Schools (and for Early Education Centers):

- 1 PRI (Primary Rate Interface) with 40 DIDs
- 1 dedicated fax line
- 1 dedicated intrusion alarm line per alarm panel
- 1 dedicated fire alarm line per FACP (minimum or as needed to meet code requirements)
- 1 dedicated line per elevator as needed
- 1 line for environmental control systems (EMS or BAS) as needed
- 1 accessible pay phone per campus
- 1 T1 line for data

Provide 8 dedicated CO ports to interface with the intercom, public address, and class/program change signaling system.

8.5.3 MIDDLE AND HIGH SCHOOLS - NEW CONSTRUCTION

System shall consist of a PBX telephone system and telephone lines with connections to other systems (i.e., intercom, public address and class/program change signaling system).

The following telephone lines are required for Middle and High Schools:

8.5.3.1 Secondary School Sites with 1 - 30 administrative phones:

- 1 PRI (Primary Rate Interface) with 100 DIDs

- 1 dedicated fax line
- 1 dedicated intrusion alarm line per alarm panel
- 2 dedicated fire alarm lines per FACP (or as needed to meet code requirements)
- 1 dedicated line per elevator as needed
- 1 dedicated line for environmental control systems (EMS or BAS) as needed
- 1 accessible pay phone per campus
- 1 T1 line for data

Provide 12 dedicated CO ports to interface with the intercom, public address, and class/program change signaling system.

8.5.3.2 Secondary School Sites with more than 30 administrative phones:

- 2 PRI with 100 DIDs
- 1 dedicated fax line
- 1 dedicated intrusion alarm line per alarm panel
- 2 dedicated fire alarm lines per FACP (minimum or as needed to meet code requirements)
- 1 dedicated line per elevator as needed
- 1 dedicated line for environmental control systems (EMS or BAS) as needed
- 1 accessible pay phone per campus
- 2 T1 lines for data

Provide 12 dedicated CO ports to interface with the intercom, public address, and class/program change signaling system.

Consult the telephone company for specific entrance facility and pay phone requirements.

Wire pay telephone outlets directly to main telephone backboard, bypassing PBX station.

8.5.4 TELEPHONE INSTRUMENT ASSIGNMENTS (OWNER FURNISHED AND INSTALLED INSTRUMENTS UNLESS OTHERWISE DIRECTED BY DISTRICT)

One attendant telephone console Type T1 in main office in Elementary Schools and 2 in Middle And High School main offices, plus one in each Small Learning Community (SLC) administrative office, if the school is designed to support (SLC's).

Multiline telephones Type T2 in Principal, Vice Principal, Assistant Principal, Dean Offices, at workstations in Attendance Office (high schools and middle schools only), head of house in SLC , in Kitchen office, and at each workstation in main office (except

at workstations where Type T1 telephone consoles are located), Work Experience Coordinator and College Coordinator offices in high schools, Counselors Offices in Adult School and for each of following offices in high schools and middle schools: Custodian, Librarian, Nurse, Doctor, Textbook Clerk, Girls P.E. Department, Boys P.E. Department, Industrial Arts Department, Grade Counselors, Counselors.

Use wall mounted telephone type T5 where no desk is available such as teachers lounge rooms.

Multiline telephones Type T3 shall not be used.

Single line desk PBX telephones Type T4 shall be used only where specifically directed.

All telephone instruments types T1, T2, T4 and T5 shall also be connected to the PA/Intercommunication System.

1 Type T6 (jack only) for each elevator.

1 Type T6 (jack only) for each fax machine.

Single-line intercommunication desk-type telephones (T4) shall be used in all classrooms and library reception desks.

Single-line intercommunication wall mounted telephones (T5) in Cafeteria, Auditorium, Computer Rooms, Faculty Lounge, First Aid Room, Music/Choral Room, Locker rooms, etc.

PBX and PA systems shall be interconnected to provide paging access capability from any designated intercommunication telephone. This is usually accomplished with dedicated CO ports from the PBX interfaced into the intercom, public address and class/program change signaling system for transparent functionally and full access from any PBX telephone into the Public Address System, but shall be PIN protected within the PA System.

8.5.5 TELEPHONE INSTRUMENT TYPES (ALL INSTRUMENTS FURNISHED AND INSTALLED BY OWNER UNLESS OTHERWISE DIRECTED BY DISTRICT)

8.5.5.1 Attendant Console Type T1

Desktop unit. Upper portion of console shall contain a 40-character alphanumeric LCD, major/minor alarm indicators, and trunk group status lamps. Lower portion shall contain a keyboard assembly that allows attendant to process various types of calls and access special features. Hearing-aid-compatible handset. Keys shall be powered from the main switching system power supply and require a cable not larger than 4-pair. DSS adjunct, if provided; may require external power.

8.5.5.2 Telephone Type T2

Desktop unit. Up to 24 buttons with flexible functionality that can be answered from the set, including inside stations and a variety of outside trunks. LCD display minimum of 2 lines x 40 characters and soft keys, line select keys, speed call keys, speaker assembly, microphone, speaker on/off key, microphone on/off key, speaker volume control and ringer volume control.

8.5.5.3 Telephone Type T3

Desktop unit. Lines can be any variety of internal or external lines. Hold key, transfer/conference redial key, program/save key, speaker on/off key, microphone/mute key, speaker/microphone assembly, speaker volume control, ringer volume control and ring control.

8.5.5.4 Telephone Type T4

Desktop unit. 2500 or equal, single-line, fully modular. Hearing-aid-compatible handset, touch tone, ringer tone switch, ringer volume control, redial key, and call/hold key.

8.5.5.5 Telephone Type T5

Wall unit. 2554 or equal, Hearing-aid-compatible handset, touch tone, ringer tone switch, ringer volume control, redial key, and call/hold key.

8.5.5.6 Telephone Type T6

Desktop unit. Type T6 (same as T4 above). Single-line phone on an independent line, separate from the telecommunications system. Provide independent line telephones at Police Office, Nurse Office, Cafeteria, and/or as determined during design..

Color: All phone sets shall be black.

8.5.6 TELEPHONE WIRING REQUIREMENTS

Wiring requirements for Types T1, T2, T4 and T5 telephone instruments is Category 5e cable terminating in a Category 5e jack as specified. Home runs shall be routed to the closest IDF dedicated voice patch panel for conversion to fiber optic cabling, including future Voice over IP network connections.

Wiring requirements for types T6 telephone instruments are one twisted pair #22 AWG, Category 3 cable terminating in an RJ-11 jack. Home runs shall be routed to the main telephone backboard (through telephone terminal cabinet of the building, if applicable).

8.5.7 PBX GENERAL REQUIREMENTS

Provide a PBX telephone system that is integrated with the public address (PA), intercom, clock, and class/program change signaling systems.

Locate the PBX in either the campus LAN Room, unless a separately designated room is called for by the program. Provide a main cross connect backboard or terminal cabinet in the LAN Room next to main telephone backboard. All wiring shall be routed via cross connect backboard or terminal cabinet through the cable tray system.

Preferred Manufacturer: **Siemens**
Nortel

PBX shall have the capability for future Voice over IP (VoIP) functionality. In either case, telephone instruments shall be connected to the PBX thru the intercom capabilities of the following types of systems, as appropriate. Intercom phones shall not be VoIP digital instruments

When designing telephone systems, take into account future requirements and make provisions for expansion in systems such as providing spare cables, sizing terminal boards with adequate spare terminals.

PBX system shall interface with the PA/Intercom system. Manual control of program tone over PA system shall be locked out when Fire Alarm System is in "Alarm." All manual and automatic program signals shall be deactivated during a fire alarm condition.

Provide a dedicated 30 amp, dedicated 208 volt, 1 phase circuit with NEMA L6-30P outlet for connection to owner furnished UPS (which supplies power to the PABX equipment).

PBX will be Owner Furnished, Contractor Installed **(OFCI).** Allow a 4' x 4' foot backboard area or floor space for mounting the owner furnished PBX.

Provide a dedicated UPS that provides at least one hour of emergency power for each system, to be Owner Furnished (from the PBX vendor), Contractor Installed **(OFCI)** under this contract).

Provide a telephone terminal cabinet in each IDF room. All cable home runs from outlets shall be routed to the closest IDF at each building. Provide separate patch panel in IDF dedicated to Voice.

Indicate on drawings the location of equipment and components, conduit and cable runs, and cable trays.

Cable home runs to IDF may be run in the same conduit or cable tray that contains data cables routed to the same IDF. Voice and Data outlets are allowed to be installed on the same multi-position faceplates/boxes.

From IDF route the telephone signals to the PBX Cabinet over the fiber-optic backbone system.

8.6 PUBLIC ADDRESS (PA) / INTERCOM / CLASS-CHANGE SIGNALING SYSTEMS

8.6.1 GENERAL

Provide an integrated communication system that includes intercom, public address (PA), clock and class/program change signaling systems, and that is interconnected with the telephone system.

Preferred Manufacturer: **Rauland-Borg Telecenter VI (with Voice over IP Communications)**
(Mfctr. Hank.Plaiser@rauland.com
Phone: 602-625-6727
(Repr.: Thompson Engineering Co. Riverside, Richard Erskine, Dennis Martinez, 909-208-9206)

or equivalent system by

Bogen Systems Multicomm 2000
(Repr: Time and Alarm Systems, Mira Loma, Gary Maret, 951-685-1761)

Dukane Systems by GE Security
(Repr. ENKO Systems, Dan Cox, Brian Myers, San B'do, 909-885-7771)

Adapt the following requirements to the specific features of the selected manufacturer.

Elementary school systems requirements are different from middle and high schools. Requirements also may be different for new school construction and existing schools. Verify specific requirements for each project.

Provide an autonomous public address system as needed for the following spaces. Autonomous PA systems shall include a program from/to line to central PA system and override capability from main PA system.

- Multipurpose rooms
- Auditoriums
- Large-group instruction rooms
- Gymnasiums in secondary schools
- Athletic fields in secondary schools

Provide at least 1 hour of emergency power for PA/Intercom system by installing a dedicated UPS unit. Provide a dedicated 120 volt circuit from UPS to each PA rack.

In rooms without a desk, telephone handsets shall be located in close proximity to teacher work station, wall-mounted at 4'0". In classrooms, telephones shall be desk-mounted with telephone jack mounted at +15" above finished floor at wall behind the desk.

In classrooms and offices, provide flush mounted baffles where new suspended ceilings are installed. Locate speaker at center of the room. Otherwise, provide surface mounted speaker baffles directly above the telephone handset at 8'0".

Design loudspeaker installation using proper types and numbers of speakers to provide adequate listening patterns in larger or special rooms and outdoor areas. Position outdoor speakers in a manner that minimizes the impact to residential neighbors of the site. Outside speakers shall also be programmed to minimize impact to residential neighbors and turned off for all signaling except emergencies during non teaching days.

Consider problems of feedback.

Provide capability to turn off speakers in office areas and conference rooms via user access software control for normal paging and class/pass signaling. All emergency pages shall be heard.

Place PA/intercom wall display for normal, emergency and 911 call display if intercom system is used as the primary phone from instructional areas and one program/microphone interface panel in main clerical core area.

Place both the PA/intercom wall display and one emergency PA microphone in main clerical core area.

When designing PA systems, take into account future requirements and make provisions for expansion in systems such as providing spare cables, sizing terminal boards with adequate spare terminals.

Main PA terminal cabinet shall be provided in the LAN Room for new construction, located near PA rack and PBX equipment. If the Main PA terminal cross connects are located inside the dedicated LAN Room, an open field (rather than a cabinet) cross connect is acceptable. If the open field solution is selected, the backboard used must be separate and distinct from the main telephone backboard and cross-connect field. All wiring between PBX and PA rack and stations shall be routed through this terminal cabinet or cross-connect.

Cabinet or backboard must be sized in accordance with number of terminations required to be made plus 20% spare capacity. Other buildings shall each be provided with at least one PA terminal cabinet sized in same manner as PA main terminal cabinet. All cabinets shall include required terminal blocks for cable terminations.

Unless otherwise approved by the District, Provide at least 1 terminal cabinet in each building, in Telecommunications Room.

Indicate on drawings a block riser diagram of entire PA system, indicating components such as speakers and intercom telephones, cable trays, conduit and cable runs and underground facilities.

Indicate on drawings the location of equipment and components, conduit and cable runs, and cable trays.

Provide grounding facilities for public address systems consisting of 3/4" conduit and a #6 THAN wire connecting main public adder. Where connection to existing building ground system is not practical, provide a separate ground rod to be used for grounding of the racks and antennas.

Fire Department requires self-supporting, non-guyed antenna masts. Ensure adequate structural support. Locate antenna masts in least conspicuous locations as viewed from main school entrance.

Indicate mounting details on drawings of antenna, speaker baffles, special speaker mounting brackets, speaker clusters, etc.

8.6.2 MAIN PUBLIC ADDRESS INTERCOM SYSTEMS

Main PA system shall consist of public address, intercommunication and class/program change signaling equipment with capacity for speakers and telephones.

Provide intercom telephone service to each classroom, wired to the main Intercom/PA rack.

Provide an intercom system that allows multiple broadcasting opportunities: main office to classroom, classroom to classroom, office or classroom to outside, etc.

When designing PA systems, take into account future requirements and make provisions for expansion in systems such as providing spare cables, sizing terminal boards with adequate spare terminals, providing conduit stub outs outside of buildings and size equipment such as PA racks and PABX to accommodate future circuits as planned, or 20% minimum expansion.

8.6.3 PUBLIC ADDRESS INTERCOM RACKS

PA rack(s) shall be located in the LAN Room, lining up with TV, MDF and other server racks. Rack(s) shall be front and rear accessible for servicing. Main PA rack(s) shall consist of free standing 19" rack(s):

- AM FM tuner. Antenna for this tuner is mounted, with suitable weather-proofing, on the roof of Administrative Building, with conduit and antenna down leads installed to PA Rack.
- Cassette tape player
- CD player and changer
- Intercom and program control panel
- Room selector panels with switch banks
- PA amplifier
- Emergency amplifier
- Microphones: 1 microphone shall be installed in main office wired to PA rack

In medium and large campuses, multiple PA racks are required to accommodate the numbers of speakers. Show the elevation of racks with all components shown. Provide adequate space to install multiple racks.

An additional function of PA speakers is to announce program/classroom change. System shall incorporate master clock system for class change signaling utilizing PA speakers. The PA rack equipment must include a multiple-tone generator. Manual activation of separate tones shall be provided for emergency call and general call.

System shall interface with Fire Alarm system to silence all speakers during a general fire alarm condition and activation of indicating devices, but shall also be capable of receiving signals from the Fire Alarm system allowing the ability for customized voice announcements from the Public Address system to provide evacuation instructions..

8.6.4 PA/INTERCOM WIRING REQUIREMENTS

Following are minimum requirements. System manufacturer’s recommended wiring shall be used.

- Intercom/PA speakers, Secondary Analog Clock, Intercom Telephone, Call-In Switch, with one Category 5e cable.
- Program/Microphone outlet, with one Category 5e cable
- Overriding autonomous PA system, with one Category 5e cable.

- MDF to IDF shall use the Fiber Cable plant.

8.6.5 INTERCOMMUNICATION PHONE INSTRUMENTS

Provide intercommunication telephone instruments as follows. (See also the section on Telephone PBX Systems).

Single-line intercom desk telephones where desks are available (designate as type ID) in classrooms.

Single -line intercom wall-mounted telephones (designate as type IW) in cafeteria, auditorium, locker rooms, faculty lounge, first aid room, music/choral room, teachers' work rooms, etc.

Connect Intercom telephone instruments to the PA/Intercommunication system through PA main terminal cabinet. The wires for speakers and intercom telephone serving a room shall be combined in a single Category 5e cable per manufacturer's standard.

Identify intercom telephones as separate from PBX telephones with drawing Symbol List and show them in appropriate locations on riser diagrams.

8.6.6 PUBLIC ADDRESS (PA) SPEAKERS

Provide PA speakers in the following locations at minimum:

Classrooms, offices, corridors, library, teachers workrooms, student store, plant manager office and all occupied rooms where no PBX telephone has been provided.

Outdoors to cover all student assembly, athletic and activity areas. Size speakers appropriate to the area covered. Do not impact adjacent residential areas.

Parking garages.

Other rooms and areas as appropriate to specific projects.

8.6.7 PAGING

PBX and Intercom/PA systems shall be interfaced to provide paging capability from any designated telephone. This is accomplished with dedicated CO ports from the PBX.

Provide a general paging zone for elementary schools and separate paging zones for secondary schools as follows:

- Individual paging zones for each grade level
- Offices only
- Zoned Corridors
- Zoned Outside Speaker
- Shops
- Gymnasium and athletic fields
- Auditorium
- Multipurpose rooms

8.6.8 GYMNASIUM AUTONOMOUS PA/SOUND SYSTEM

Provide the following:

Terminal cabinet for termination of all inputs and outputs of the system. Freestanding 19" rack with mixer preamplifiers, power amplifiers, cassette tape player, AMFM radio, and graphic equalizer. Rack located in the gymnasium office. Provide dedicated 120 volt circuit for autonomous PA rack.

AM/FM antenna mounted, with suitable weather-proofing, on roof with download in conduit to radio tuner and grounding. Loudspeakers in gymnasium court consisting of a cluster of minimum 4-horn loudspeakers mounted near ceiling in center of room so as to cover all quadrants of room. Mount cluster in a steel enclosure firmly anchored to ceiling or roof structure.

Two microphone outlets mounted flush with finished floor at courtside at centerline. Next to microphone outlets, provide (2) 120 volt, 15 amp receptacles flush with finish floor.

One microphone outlet in each of the Girls and Boys Coaches Offices.

Provide Program line to main PA rack in administrative unit to distribute local programs to main PA system.

Provide emergency override line, including relays, to override local program from main PA console.

Assisted Listening Systems as required by Title 24.

Provide program from main PA rack to allow broadcast of main PA system programs and announcements in gymnasium areas.

8.6.9 MULTIPURPOSE ROOM AUTONOMOUS PA/SOUND SYSTEM

Provide the following:

Wall mounted amplifier in cabinet with a minimum of 8 input sources for tape, projector, and 5 microphones. Amplifier cabinet shall be flush or surface mounted and located back stage. Provide dedicated 120 volt circuit for autonomous PA wall mounted rack.

Input/output switching panel mounted adjacent to or below amplifier cabinet.

Three floor microphone outlets flush mounted near front of stage platform, equally spaced and wired to preamplifier mixer inputs.

Microphone outlet flush mounted in front face of stage platform and wired to preamplifier mixer input.

Microphone outlet flush mounted in floor at center of audience area and wired to preamplifier mixer input.

Speakers mounted on either side of the stage platform and wired to amplifier outputs.

Projector outlet flush mounted in floor at center of audience area and wired to preamplifier mixer input.

Receptacle, 120 volt, 15 amps, flush mounted in floor at center of audience area.

Assistive Listening Systems as required by Title 24.

Program line to main PA rack in administrative unit to distribute local programs to main PA system.

Emergency override line, including relays, to override local program from main PA console.

Program from main PA rack to allow broadcast of main PA system programs and announcements in multipurpose room areas.

8.6.10 LARGE GROUP INSTRUCTION ROOM AUTONOMOUS PA/SOUND SYSTEM

Large group instruction rooms are rooms with capacity for 100 students or more, but without a stage. Provide the following:

Wall mounted amplifier in cabinet with a minimum of 8 input sources for tape/CD, audio from laptop computer, projector, and 4 microphones. Amplifier cabinet shall be flush or surface mounted in closest signal room. Provide dedicated 120 volt circuit for autonomous PA wall mounted rack.

Input/output switching panel mounted adjacent to or below amplifier cabinet.

Microphone outlet flush mounted on instruction wall at +48" IE and wired to preamplifier mixer input.

Microphone outlet flush mounted in floor at center of audience area and wired to preamplifier mixer input.

Two infrared wireless microphones.

Speakers mounted above instructional wall and wired to amplifier outputs.

Projector outlet flush mounted in floor at center of audience area and wired to preamplifier mixer input.

Receptacle, 120 volt, 15 amp, flush mounted in floor at center of audience area.

Program line to main PA rack in administrative unit to distribute local programs to main PA system.

Assisted Listening System if required by Title 24.

Emergency override line, including relays, to override local program from main PA console.

Program from main PA rack to allow broadcast of main PA system programs and announcements in multipurpose room areas.

8.6.11 AUDITORIUM/THEATER AUTONOMOUS PA/SOUND SYSTEM

Provide the following:

Terminal cabinet for termination of all inputs and outputs of system, except inputs of wireless microphones.

Freestanding 19" rack backstage with mixer preamplifiers, power amplifiers, cassette tape player, AM/FM radio, graphic equalizer, and receivers for wireless microphones. AM/FM antenna mounted, with suitable weather-proofing, on roof with download in conduit to radio tuner, and grounding. Dedicated 120 volt circuit for autonomous PA wall mounted rack.

Three microphone outlets mounted flush in stage platform, overhead, and in stage platform front. Each microphone outlet shall be wired to one input of preamplifier mixer. Wireless microphones and receivers shall be provided. Each wireless microphone receiver shall be wired to one preamplifier mixer input.

Projector outlet in control room wired to preamplifier mixer input.

Speakers shall be provided to produce a uniform sound level throughout auditorium. A sound system analysis shall be done to properly locate sound columns.

A telephone intercom system shall be provided between projection room and backstage for stage cueing and lighting coordination. System shall include headsets, power supplies and input jacks.

Assistive Listening System as required by Title 24.

Program line to main PA rack in administrative unit to distribute local programs to main PA system.

Emergency override line, including relays, to override local program from main PA console.

Program from main PA rack shall allow broadcast of main PA system programs and announcements in auditorium building areas.

In Performing Art Centers/Theaters (new facilities), a theater consultant hired by the architect shall determine the scope of sound system beyond the requirements defined here.

The electrical engineer shall coordinate with theater consultant and architect to provide power, cabling, racks, speaker clusters and raceways where needed.

8.6.12 ATHLETIC FIELD AUTONOMOUS PA/SOUND SYSTEM

Provide the following:

Wall-mounted amplifier in cabinet with a minimum of 8 input sources for tape, projector, and 5 microphones. Cabinet flush or surface mounted, located in sound control booth. Dedicated 120 volt circuit for autonomous PA wall mounted rack.

Input/output switching panels mounted adjacent to or below amplifier cabinet.

Wall mounted microphone outlet at coach office wired to amplifier inputs.

Microphone outlet mounted on an appropriate light pole or at concession room and wired to amplifier input.

Outdoor horn loudspeakers to cover all PE fields.

Program line to main PA rack in administrative unit to distribute local programs to main PA system.

Emergency override line, including relays, to override local program from main PA console.

Program from main PA rack to allow broadcast of main PA system programs and announcements in auditorium building areas.

8.7 CLOCK AND PROGRAM SYSTEM

Clock and Program System shall be included as part of the Integrated Communication System eliminating the need for a separate conduit network.

Clock and Program/Change Tone System shall be supervised, with atomic master clock time control, which upon the return of power after a power failure will automatically and individually correct each secondary clock and program time circuit. In addition secondary clocks shall provide instant correction with power failures of up to 6 hours.

In new school construction, and in new building additions to existing school sites and modernization projects, program/classroom change tones will be announced using the public address (PA) speakers. Provide connections from clock controller to PA rack.

Provide connection to fire alarm control panel. Provide lock out for both manual and automatic tone when fire alarm system is in alarm.

Provide 16 (sixteen) separate program bell schedules and 16 (sixteen) program classroom bell change zones.

Interior clocks shall be 12" diameter, round, semi-flush and mounted in the clock/speaker baffle combination unit at 8'0" above floor unless shown otherwise – on primary instructional wall in classrooms.

Provide interior clocks in all classrooms, administrative unit offices, cafeteria, kitchen, locker rooms, teachers' lounge, library, auditorium and gymnasium.

Exterior clocks shall be 16" round, with weatherproof housing with polycarbonate protective cover.

In classrooms for the deaf and hard of hearing, and in rooms with high ambient noise (band and or choral rooms, some shops), provide visual units, which are substantially different in appearance from a fire-strobe indicating appliance, to indicate program/classroom change. The applicability of this requirement must be approved by the District. If required, the engineer must develop specifications for the units and power supplies.

Master clock controller shall be incorporated in the Public Address (PA) Intercom rack located in the LAN Room (new schools).

Provide applicable terminal cabinet, complete with required terminal blocks, in each building, for distributing cable terminations.

Coordinate with the public address/intercom/telephone and class change signaling requirements of this manual.

At existing school sites with an existing master clock system, new clocks shall be same make as existing master time control or clocks that are compatible with existing system. When adding new clocks to an existing system, provide the District with confirmation from the clock manufacturer that new clocks will work with the existing clock system; then provide the appropriate design for a single comprehensive system.

Clocks shall be provided with locking safety tab designed to ensure that they remain in place during earthquakes.

8.8 SECURITY INTRUSION ALARM SYSTEM

8.8.1 GENERAL

For purposes of management effectiveness, monitoring efficiency, and maintenance standardization and economy, the District has selected a single combined intrusion-detection-alarm, fire-alarm, and door-access-control system, that has been approved by DSA and CSFM. It shall be specified, subject to "or approved equal" provisions in **Division 28, Electronic Safety and Security,** of CSI Master Format, 2004 Edition.

System shall be IP and Web-based so monitoring and control can be done over any network-connected computer in the District's wide-area network. Operator interface shall include site and building floor plans to show all alarm devices.

System & Manufacturer: **EST3 "Synergy" with "Fireworks," by GE Security (formerly Edwards Systems Technology)** or approved equal
(Repr. Drew Turner, GE Security, 909-629-1827; and ENKO Systems, Dan Cox, San B'do, 909-885-7771)

The following information has been written for a stand-alone intrusion-alarm system. Utilize the functionality as appropriate for the combined fire and security alarm system.

Provide a security intrusion alarm system that reports through the LAN Room to the District WAN Room and to the School Police Department headquarters.

Alarm system consists of four basic elements: input, processing, output, and receiving.

The input element is an addressable sensing device designed to monitor status of a protected area in a school, such as a motion detector or a door switch. The addressable sensing devices, or intrusion detectors, are connected together and then to a control panel via twisted wire cable.

A small amount of current constantly flows through the cable to the addressable sensing device. If current passes without interruption, there is no alarm. However, if one of the detectors is disrupted, opened, or the cable is cut, the addressable sensing device senses the absence of current in the loop and sends a signal to the control panel.

Upon receiving this alarm, the control panel provides power necessary to activate an output device: a digital communicator or alarm. Within seconds, the panel begins sending programmed digital signals to the FireWorks central monitoring station via the WAN, when the station displays the alarm information graphically and as alarm text.

This process shall be adapted to the specific requirements and features of the alarm manufacturer, to achieve the results described.

8.8.2 SENSING DEVICES

8.8.2.1 Motion Detectors

Motion detectors (occupancy sensors) shall be passive infrared. (If Lighting Control System sensors are used, they will meet the dual-mode requirements of that system – see ADM Section, "Electrical Power and Lighting.")

Security-system motion detectors are required in all areas or rooms that are located along the perimeter of the first floor of a building. (Almost all larger occupied spaces will have dual-mode lighting-control motion detectors.)

Provide security motion detectors in spaces located above the first floor only if there is outside access or potential for entering directly by roof access, climbing trees, etc.

Provide motion detectors in corridors and hallways on each floor of a building.

Provide motion detectors in Computer Rooms, LAN Rooms, Telecommunications Rooms, and Multipurpose Building, Kitchen and Dining Rooms, Gymnasium and all major spaces.

Install motion detectors on an outlet box on the ceiling to obtain maximum efficiency. Use wall mounted detectors only where ceiling-mounted are impractical.

Locate the motion detector at a corner of a space, facing away from sunlight, heating elements, HVAC outlets, and any turbulent air movements.

Provide remote control panel including a 12VDC power supply in each building for motion detectors.

8.8.2.2 Door Switches

Door switches shall be of magnetic type.

Provide door switches for walk-in freezers or coolers in a kitchen.

Provide door switches for all exterior doors not covered by motion detectors on the interior, including restrooms with direct exterior access, and at any other door locations required by the District for a specific project.

8.8.3 ALARM ZONES

Each addressable sensing device shall be identified with an alarm zone or alarm point, which shall be identified at the remote annunciator and at the control center. The zone or point identification shall be descriptive of the location of the sensing device, such as Administrative Building Room 120.

Provide a Site Plan and Building Floor Plans to graphically display the device in alarm.

There shall be no more than two motion detectors per zone or no more than two points to identify the location. Areas where two detectors per zone may be required include multipurpose buildings, gymnasiums, auditoriums, and two-classroom relocatable buildings.

Zones or points shall be listed and indicated on site and building drawings, identifying each one by building, area and room number.

8.8.3.1 Zone Bypass Keypads

Provide a zone bypass keypad at the interior wall of the Main Office, Kitchen, Cafeteria, Student Store, Gymnasium Lobby, Multipurpose Building, Auditorium/Theater, Adult School Office, Computer/Multimedia/Science laboratories, Music/Band Room, offices of academies in multi-academy learning centers, and Plant Manager Office to deactivate the alarm when entering a building is necessary after the alarm system is armed.

Individual Zones may be grouped into partitions per site to allow for arming and disarming of the partition (or group of zones) from a Keypad. There shall be a maximum of 255 partitions per site.

A separate keypad will not be required, if any of the areas listed above is only accessible through another controlled area with a keypad.

The bypass keypad shall be a liquid crystal display.

Do not locate keypads in corridors or other areas easily subject to damage.

Consult with District representative to determine if other locations may be required.

8.8.4 MAIN SECURITY PANEL (MSP) AND ANNUNCIATOR

Main Security Panel and Annunciator are also called head-end equipment. They are used to annunciate alarm zones and to transmit alarm signals via District WAN to the Fireworks central monitoring station located at the District School Police Headquarters.

MSP consists of minimum of 125 zones, expandable to 1,250 zones by the use of SLC expansion modules, each with tamper inputs, dual phone line monitor and power supply housed in a lockable cabinet. Controller shall be located in the LAN Room (new facilities) or TR in administration unit (existing facilities).

In campuses where numbers of zones exceed 1,250, or in campuses where total com-bus wiring from the controller to a remote security panel or to any keypad connected, exceed 4,000', split the campus to be protected with two independent controllers. Both controllers shall be annunciated in the main office.

MSP shall be fed from a separate circuit of 120 volt power source.

Annunciator shall be located in the clerks office of the administration unit. Annunciator shall have full LED annunciation for all zones, tamper loop, and dialer output interface. Provide a keypad at each annunciator.

8.8.5 REMOTE SECURITY PANELS (RSPS)

Provide a Remote Security panel at each building (except relocatable buildings where a group of relocatables may be controlled by one RSP), connected to the main security panel by com-bus wiring.

RSP consists of minimum of 125 zones, expandable to 1,250 zones by the use of SLC expansion modules, each with tamper inputs, dual phone line monitor, and power supply housed in a lockable cabinet.

RSP shall be fed from a separate circuit of 120 volt power source.

The RSPs shall be located in Telecommunications Rooms.

8.8.6 POWER SUPPLY, CABLES, RACEWAYS AND CABINETS

Cables used for connection between MSP and annunciator in clerk's office, all home runs from sensing devices to MSP/RSP and com-bus wiring between MSP and RSP and wiring to the keypads shall be #18 TWP for up to 4,000,' as required by the system manufacturer.

Cable length, resistance and capacitance must be designed by the Architect to strictly conform to the manufacturer requirements.

Power supplies consisting of receptacles, transformer/ rectifier and batteries shall be installed in a lockable NEMA 1 enclosure or a lockable terminal cabinet.

8.8.7 TERMINAL CABINETS AND JUNCTION BOXES

At least one terminal cabinet shall be provided in each building except relocatable buildings.

At least one junction box (6"x 8") shall be provided in each relocatable building.

8.8.8 EXISTING SECURITY INTRUSION ALARM SYSTEMS

At some District school sites existing intrusion alarm equipment may differ from the system described above.

Existing system headend equipment may consist of an annunciator/switch panel, a relay panel and a dialer or transponders.

If this situation is encountered, remove existing annunciator/switch panel, relay panel, dialer or transponder. Wire all existing zones directly to new controller. A new readily accessible annunciator panel shall be installed.

8.8.9 SITE PLAN

Specify that the contractor shall provide a site plan, in digital form, for use by the District central monitoring stations. Site plan shall be as follows:

- Indicate location of buildings and zone numbers.
- Indicate location and groups of zones contained in partitions
- Indicate school code number and zone chart.
- Indicate surrounding street names and direction.

8.9 DOOR ACCESS CONTROL SYSTEM

For purposes of management effectiveness, monitoring efficiency, and maintenance standardization and economy, the District has selected a single combined intrusion-detection-alarm, fire-alarm, and door-access-control system, that has been approved by DSA and CSFM. It shall be specified subject to “or approved equal” provisions in **Division 28, Electronic Safety and Security,** of CSI Master Format, 2004 Edition.

System shall be IP and Web-based so monitoring and control can be done over any network-connected computer in the District’s wide-area network. Operator interface shall include site and building floor plans to show all alarm devices.

System & Manufacturer: **EST3 “Synergy” with “Fireworks,” by GE Security (formerly Edwards Systems Technology)** or approved equal.

(Repr. Drew Turner, GE Security, 909-629-1827; and
ENKO Systems, Dan Cox, San B'do, 909-885-7771)

The Architect must consult with the District regarding project requirements and design provisions for door-access control.

8.10 VIDEO AND AUDIO SURVEILLANCE SYSTEMS

8.10.1 GENERAL

As part of the SBCUSD commitment to provide a safe working and learning environment, surveillance systems are to be used in approved, designated areas of schools and school grounds, where there is no expectation of privacy, as an additional means to continue to provide for that safe environment.

Video surveillance systems are defined as electronic devices for visual image (only) monitoring, recording and visual image data storage. (Parking garages are an exception and have audio monitoring and recording as well as video.)

SURVEILLANCE SYSTEMS ARE STRICTLY PROHIBITED WHERE A "REASONABLE EXPECTATION OF PRIVACY" EXISTS. This includes the following:

- No surveillance shall be installed in such spaces as restrooms, locker rooms, classrooms, private offices, and private workspaces.
- Cameras must be directed so that they do not look through windows or other openings into private areas.
- Cameras providing outside surveillance, such as parking lots or building perimeters, must not be directed beyond school property.
- All real time visual monitoring equipment (except point of entry monitors), including monitor screens, consoles, controllers and other appurtenant equipment, and data recording devices, must be located in a secure monitoring site, with restricted access by approved individuals only. Do not locate them in a common LAN equipment room.
- Secure monitoring sites may be located, secure from public viewing, in the Principal Office, Assistant Principal Office, School Police Office, or a special security room. For adult education or other after-hours use, the same provisions apply; systems must be able to be secured from unauthorized use.

Provide video surveillance systems as follows:

- Parking Garage Systems: in all parking structures (audio surveillance is also required).
- School Building and Site Systems: Only when directed in writing by the SBCUSD representative. (These systems shall be video only. NO AUDIO SURVEILLANCE OR RECORDING.)

8.10.2 PARKING GARAGE SURVEILLANCE SYSTEM

Provide a video surveillance system, cameras and other equipment to monitor all parking garages.

Provide an audio surveillance system consisting of controller, microphones, speaker/ microphones, combiners, and call stations.

The basic Parking Garage Surveillance System requirements are as follows:

- (1) camera with pan and tilt capability spaced every 100’ and within vandal-resistant enclosure in parking structures or as approved by District.
- (1) fixed camera within vandal resistant enclosure installed inside the parking structure entrance. Field of view shall include the vehicle access gate to the parking lot.
- Surveillance microphones spaced every 60’ or at a distance approved by District, with a maximum of 6 microphones per zone.
- Push to talk emergency speaker/microphone call stations every 50’ in garage or at a distance as approved by the District, one at elevator lobby and one at each pedestrian point of egress.
- (16) video cameras maximum per DVR.
- (1) monitor for each group of sixteen cameras.

Locate monitors, digital video controller and recorders (DVR) and audio surveillance base stations system in a console/rack station either in the School Police Headquarters, with a secondary monitor in the school administrative unit and, for parking garage systems, in the LAN Equipment room.

The video surveillance system shall be designed to be integrated with a School Building and Site System, either concurrently or in the future.

8.10.3 SCHOOL BUILDING AND SITE SURVEILLANCE SYSTEM (AT SELECTED SITES ONLY)

Provide video surveillance system, cameras and other equipment to monitor any spaces where safety or security risks indicate a need and the District has given written directions to provide the system. Specific needs include:

- Main Office and Reception public spaces
- Attendance Office public space
- Corridors, lobbies, and other public circulation and access spaces
- Cafeteria
- Lunch Shelter
- Other interior and exterior locations determined during project design phase

8.10.4 SYSTEM DESIGN REQUIREMENTS

System shall be an IP Networked Video Surveillance System (VSS), consisting of digital video cameras, camera enclosures, monitors, switcher/controller system, encoders, digital video controller and recording devices, pan/tilt/zoom drives, cabling, power supplies, raceways, and structural supports for all equipment.

(Where there is a garage, the head-end equipment shall be integrated with the parking garage surveillance system to provide a single campus-wide system.)

System shall have the capability to be linked to the building access control system, to allow visual verification of a building access event.

System shall be based on the **OnSSI** Platform by On-Net Surveillance Systems, a comprehensive IP Video Surveillance software solution that provides automated event detection and intelligent video delivery through convergence with security and IT systems and networks, and is capable of working with any cameras and future plug-in systems or devices.

System Manufacturer: **Sony Electronics Video Surveillance System and Cameras** (Thompson Engineering Co. Riverside, Richard Erskine, 909-208-9206)

or equivalent systems and components by

Bosch Security Systems

GE Security

Provide fixed video cameras to cover all corridors, stairwells, elevator lobbies, and other appropriate interior public areas. Use pan/tilt/zoom cameras only for areas designated specifically for people surveillance activity.

Provide (16) cameras maximum for each monitor and DVR, fewer if design and monitoring conditions warrant.

Cameras shall be located so that every camera is monitored by at least one other camera.

All cameras shall be in vandal-resistant enclosures.

Cameras shall be located and secured so as to minimize vandalism, but there shall be no covert or concealed cameras. Support and fix all cameras securely to building structural elements, not to ceiling systems.

No audio surveillance shall be provided for this system.

Provide drawings at Design Development and Construction Document Phases that show all camera locations and zones of coverage.

At all schools using building and site video surveillance systems, appropriate signage must be posted to advise the public that the systems and camera are in operation. Standard sign language and format is available on request. Signs must be placed prominently at all points of entry to the school site, both pedestrian and vehicle. Where

surveillance is provided in parking garages, place the sign at the entrance to the parking garage. Location of signs shall be submitted at Design Development Phase for the District review. Signage with details must be shown in project construction documents.

8.11 TELEVISION SYSTEMS

Provide a centrally managed Internet-based streaming media system for the distribution of television content throughout the school over the Local Area Network. System shall handle a wide range of media content, including cable, satellite, or on-air broadcasting, DVD's, VHS tapes, and live camera feeds (from a school studio).

System Manufacturer:

Rauland-Borg Telecenter CPS Digital Multimedia System
(Mfctr. Hank.Plaiser@rauland.com
Phone: 602-625-6727
(Repr.: Thompson Engineering Co. Riverside, Richard Erskine, Dennis Martinez, 909-208-9206)

or equivalent system by

Bogen Systems Multicomm 2000
(Repr: Time and Alarm Systems, Mira Loma, SGary Maret, 951-685-1761)

8.11.1 BROADCAST TELEVISION

Television sources that might be available include:

- Cable TV system (CATV) provided by local cable TV distributor.
- Satellite TV system provided by local provider.
- Off-air master antenna system (used when CATV is not available).

The Architect shall consult and coordinate with the District and with the television service provider in requesting service, and shall include in the contract documents the drawings and specifications provided by the provider. Requests must be made early in design, to allow sufficient time for obtaining service provider engineering input.

8.11.1.1 Television System Equipment

General broadcast TV system and equipment includes:

- Head-end equipment: in the main LAN Room: Headend 19" rack with mixing networks, channel converters, processors, splitters, combiners, modulators, directional couplers, test taps, line amplifier, and video monitor.
- Line extender TV cabinets including amplifiers to be located in the IDF (Signal room) of remote buildings.

8.11.1.2 School with CATV Systems

A cable drop from local cable TV distributor or satellite service provider shall be terminated at a cabinet as required by the provider. Provide a coax-11/U cable connection from CATV cabinet to head-end rack.

8.11.1.3 Schools with Satellite Television System

Satellite antenna 3.7 meters in diameter or size as approved by the District mounted on roof of Administration Unit or on platform at ground level, with direct line of sight to all satellites

Feed antennas, C and Ku bands low noise amplifiers/block down converters, motor drive actuator and sensor.

Satellite receiver shall be mounted in television distribution system rack.

Modulator at VHF Channel 12 frequency shall be installed in the TV headend rack.

8.11.1.4 Schools with Off Air Master Antenna Television System

Used where Cable TV is not available.

UHF and VHF antennas mounted on roof of administration unit.

For antenna down leads, coax RG-6/U cable.

8.11.2 TELEVISION SYSTEM DISTRIBUTION, CABLING AND POWER

Use the LAN fiber-optic backbone cabling and Cat 5e/6 horizontal cabling to distribute streaming TV signal to remote monitors. For classrooms, use the fiber drop to the teacher's desk to send the signal to the teacher's computer for passing to the monitor or projector and the audio equipment. (Cat 5e or 6 cable may be used with manufacturer's approval for relatively short runs.)

Use the Telecommunications Room for termination and cross connects in a TV cabinet or rack.

Provide 120 volts, 20 amps, dedicated circuit to head-end rack and cabinets.

Terminal outlets shall be mounted 18" above finished floor at TV monitor location..

TV outlet shall be provided at VCR/ DVR location (media cabinet) and at teacher workstation. A single TV drop from cable tray shall serve VCR/DVR and extend to the teacher TV outlet.

Provide an S-video connection from teacher station to TV monitor and/or projector.

Use of category 5e cable for S-video connections will be acceptable for most locations. Provide alternate cables where higher resolution is required.

Provide S-video outlets at ceiling for projector (or at TV monitor at wall) and at wall next to teacher workstation.

Provide 120 volt, 15 amp receptacle at TV and projector outlet.

Antenna mast, cabinets and raceways shall be effectively grounded.

Submit system calculations indicating signal levels at components including terminal outlets. All block diagrams and construction details must be included in construction drawings.

8.12 SOUND ENHANCEMENT SYSTEM

8.12.1 APPLICATION

In all classrooms provided with an overhead digital projector for projecting video images from computer or TV signal, and for any other instructional areas where directed for a specific school project, provide a sound enhancement system.

System provides for voice and other audio signal input for the audio component of any AV presentation, as well as distribution of teacher's or student's voice from a wireless infrared microphone.

8.12.2 DESCRIPTION

Speakers: Minimum of 4 mounted in ceiling and located to provide uniform sound distribution throughout the room regardless of the arrangement of teacher and students.

Receiver/amplifier: Located at front of classroom, in casework provided for other AV equipment and 4'-6' above the floor. The system shall be interfaced with teacher work station to amplify sound output of ceiling projector of presentations and programs initiated by VCR/DVD or teacher computer. Provide 1 mono input and at least 2 stereo inputs, with independent control of level from each input.

Infrared sensors: Located in receiver and in ceiling to receive signal from microphones.

Microphones: Collar mounted and hand held, for infrared transmission of speaker voice to sensors.

System Manufacturer: **Audio Enhancement Co**. Salt Lake City, Utah
(Tom Dobson, 800-383-9362)

or equivalent system by

Bogen Systems Classroom Enhancer,Mira Loma, CA.

8.13 SCHOOL RADIO COMMUNICATION SYSTEM

8.13.1 SYSTEM REQUIREMENTS

Each school may have a radio communication base station to support its hand-held portable radios. It is provided by the District, and is located in the open office of the administration unit, usually on top of file cabinets or on special shelving. It receives signals from a roof mounted antenna.

A conduit for the antenna cable from the roof to the room is required as part of the building construction, terminating in a receptacle at the base station location and in a weather head on the roof.

8.14 SIGNAL SYSTEMS RACEWAYS & TERMINAL CABINETS

8.14.1 RACEWAYS

All signal systems wiring and cabling, including fire alarm, clock, security intrusion alarm, telephone, public address, television, computer networking, and BAS, shall be installed in raceways, except for low-voltage communication or signal wiring for local distribution above ceilings within classrooms or similar small areas, where they may be organized and suspended in approved hangers.

Fire alarm systems shall be installed in conduit. For all other signal systems, cable trays are preferred for inside-building distribution.

Cable Trays: Metal ladder or wire, divided in three sections. Center-supported on threaded rods, in accordance with NEC, NEMA, and CTI standards. Separate computer network and voice systems (including telephone/intercom/PA/clock) in one section; security, access control, TV in another section; and BAS cabling in third section. Secure separately with ties or tie-downs.

Hangers: Erico Caddy CAT21, 32, 425 as appropriate for number of cables. Route cables in hangers parallel to room wall, in organized manner to eliminate above-ceiling clutter.

For inside building distribution, the sizes of conduits or cable trays shall be selected based on 40% cable-fill requirements for different systems.

For underground distributions to all buildings, signal systems shall be installed in conduit, sized for 40% fill (30% fill for new campus to accommodate future growth), with the following as a minimum standard:

- 4” C- for Fiber Optic Data Backbone System with three innerducts – two 1 ½” and one 1”.
- 3” C- for Cat. 6e data cables
- 3” C- for TV distribution (coaxial cables if applicable).
- 2” C- for Fire Alarm System if necessary.
- 3” C- for Spare.
- 3” C- for Minimum of two for main public telephone entrance service.
- 2” C- for Minimum of one for CATV entrance service.

For end drops to small buildings not containing more than two classrooms, and short distance from the Telecommunications Room (and without its own), the conduit size may be as follows as a minimum standard:

- 3” C-Fiber Optic Data Backbone System.
- 2” C-Cat. 6e data cables/ TV distribution (coaxial cables if applicable).
- 2” C-Fire Alarm System.
- 2” C-Spare.

On existing campuses, cable may be installed in existing underground conduit if space is available. Any cables pulled out from an existing conduit shall be replaced with new.

8.14.2 TERMINAL CABINETS AND BACKBOARDS

Terminal cabinets shall be provided for each signal system, in each building. Cabinets shall be sized in accordance with number of terminations required to be made plus 20% spare capacity.

The information indicated here are supplemental to requirements indicated elsewhere in the design standards.

9. PLANTING AND IRRIGATION

9.1 GENERAL REQUIREMENTS

Landscapes are essential to the quality of life by providing areas for active and passive recreation and as an enhancement to the environment by cleaning air and water, preventing erosion, offering fire protection, and replacing ecosystem lost to development.

Schools represent important visual elements in the community; therefore a well conceived landscape design is essential. One that is economically maintainable and water efficient yet still provides a naturally beautiful campus that enhances its neighborhood.

Adequate shading of outdoor teaching, gathering and play areas with year round shade trees; durable plants that need little pruning or shaping; drought tolerant landscaping that provides ease of maintenance are important elements of the landscape development.

Specify the work of this sub-section in Division **32 90 00, Planting,** in accordance with CSI Master format 2004 Edition.

9.2 PLANTING

Examine existing trees on site, identify those that should be preserved, and incorporate them into site planning, with recommendations to the District that they be saved in place or relocated, and provide method of protection during construction.

See ADM Vol 1 - School Site General Criteria, for planning and design criteria on landscaping, planting and tree locations.

Refer also to “Pest Control” in the “Architectural” section of this Volume, for criteria on plant placement adjacent to buildings in regards to pest management plans.

Trees shall be spaced to provide a maximum of 5’ of overlap of full canopies. No trees shall be specified less than 24” box size.

Use plant materials appropriate to the site and project, selected from the SBCUSD plant lists below.

9.3 SOILS

Examine physical properties of the existing soil at site and provide during the Design Development Phase a preliminary assessment of possible major soil problems, such as salinity and alkali conditions, and the need for soil amendments or imported topsoil.

Consult with the District regarding services of a soil specialist and laboratory testing during the design stage.

Provide for stockpiling of good existing topsoil to be used in planting areas, free of all debris and rock over 5/8”.

Specify characteristics and source approval for topsoil to be imported, installation methods and blending if appropriate.

Specify subsoil ploughing and subsurface drainage to alleviate problems created by poor aeration, soil compaction or inadequate drainage.

Specify replacement of top 3 feet of soil where trees are planted in existing paved areas or other heavily compacted soils.

Indicate method of slope stabilization on banks 2:1 or steeper.

On plans indicate the area (in square feet) of each planting area.

9.4 IRRIGATION

9.4.1 DESIGN REQUIREMENTS

Design requirements shall be consistent with the California Code of Regulation, Title 23 Water, Division 2 Department of Water Resources, section 2.7 State Model Water Efficient Landscape Ordinance, Section 490-495.

Specify the work of this sub-section in Division **32 80 00, Irrigation,** in accordance with CSI Masterformat 2004 Edition.

9.4.2 DESIGN CRITERIA

In order to ensure a high degree of water efficiency, all irrigation systems shall be provided with automatic controllers with electrically operated control valves and seasonal irrigation schedules, incorporating water conservation design and utilizing methods appropriate for specific terrains, soil types, wind conditions, temperatures and other environmental factors.

Soil types and infiltration shall be considered when designing irrigation system.

All irrigation systems shall be designed to avoid runoff, low-head drainage, overspray, or other similar conditions that could cause water to flow onto adjacent property, non-irrigated areas, walks roadways, or structures.

Special attention shall be given to avoid runoff on slopes and to overspray in planting areas with a width less than 10’ and in median strips.

Provide irrigation schedules for each station that include sequences of cycle and soak times.

Select the proper equipment components and provide irrigation schedules for each station to meet or exceed the required irrigation efficiency of 0.625.

Irrigation system must be sized to water all sport fields within an 8 hour period and the entire site (including sport fields) within a 12 hour period.

Do not use booster pumps to meet head and flow requirements.

Drip irrigation is acceptable for planter areas.

9.4.3 DESIGN DOCUMENTS

Design documentation package shall include information as detailed in the State Model Water Efficient Landscape Ordinance, Section 492(b & c). Provide all formulas and calculations to support quantities shown.

Each landscape documentation package shall include a cover sheet, referred to as the Water Conservation Concept Statement. It serves as a check list to verify that the following elements of the landscaping documentation package have been completed:

- Maximum applied water allowance
- Estimated applied water use
- Estimated total water use
- Landscape design
- Irrigation Design Plan -- Include the square footage of the landscape area for each station, zone, controller, as well as total square footage for all landscape area
- Irrigation watering schedules, including soak times
- Maintenance schedules
- Landscape irrigation audit schedule
- Final grading design plan
- Soil analysis

9.4.3.1 Site Plans

Master site plan shall include showing the location of all irrigation zones for each controller with point of connections, backflow device, pressure regulators, isolation valves, mainlines, flow sensor/master valve & conduit, remote valves stations and quills.

A complete plan layout for each controller shall show the location of the point of connection to the main piping system, main and lateral lines, isolation valves, pressure regulator, master valve & conduit, flow sensor & cable, remote valves, rain sensor, controller and all sprinklers

9.4.3.2 Design Calculations

Provide design calculations to support incorporating a pressure regulator.

Provide hydraulic calculations per station to support irrigation design plans using the following format:

- Static water pressure - high and low
- Water meter- size, friction loss @ required GPM
- Backflow device- size, friction loss @ required GPM
- Master valve- size, friction loss @ required GPM
- Flow sensor- size, friction loss @ required GPM
- Isolation valves - size, friction loss @ required GPM

- Mainline piping - size, developed length, friction loss at each sizes used @R/GPM
- Lateral piping - size, developed length, friction loss at each sizes @R/GPM
- Remote Valves - size, friction loss @ required GPM
- Elevation change
- Total pressure loss
- Pressure required @ sprinkler head
- Lowest static pressure (-10%)
- Residual water pressure

9.4.3.3 Design Materials and Components

The following are some notable required material choices that shall not be compromised:

- All valves including remote valves, isolation and shutoff valves shall be brass or bronze. Plastic valves are not acceptable. Preference: Superior 950 control valves.
- Mainline and lateral PVC piping shall be a minimum schedule 40. PVC piping above ground is not acceptable. Preference: PVC up to 3". Class 315 on larger sizes.
- Do not use flexible polymer tubing.
- Do not use PVC male adapters. Use schedule 80 PVC nipples when connecting to copper, brass, bronze or steel materials.

9.4.3.4 Water Supply, Meter and Backflow Devices

Provide a separate irrigation water meter and main of adequate size to satisfy maximum instantaneous demand and projected future demands. (See also ADM Section, "Civil Engineering/ Water Distribution")

Provide a separate 4" (minimum) connection to water source.

For large sites, 3 or more watering acres, or any multiple of that in unit size, there may be separate points of connection on designated irrigation meters for each such unit.

Water piping from meter connection to backflow device shall be no smaller in diameter than backflow device served.

Provide reduced pressure principle backflow prevention devices upstream from irrigation system to prevent backflow.

Provide pressure regulator when necessary, never exceeding 100 psi.

Provide enclosure for backflow device and pressure regulators where necessary to reduce potential vandalism.

9.4.3.5 Piping Design

Flow velocity: 5' per second maximum, based on industry standard friction pressure loss values and complete hydraulic calculations.

Pipe size shall be sufficient to support a minimum of two control valves operating at the same time (one opening, one closing).

Follow the manufacturer GPM demand and pressure requirements; make allowance for a 10% error margin with all GPM demand and sprinkler head coverage values.

Size all valves, including remote control valves, no smaller than the piping served downstream, except that when piping is increased in size to reduce friction loss, remote valves may then be sized one pipe size smaller than the piping served.

Install shut off valves needed to isolate loop systems or major branch lines.

Do not use exposed PVC piping above ground.

Buried galvanized pipe must be wrapped per industry standards.

Pipe burial depths:

- Mains – 24” minimum
- Laterals – 18” minimum
- Bed all piping in a minimum of 4” of clean sand

9.4.4 PLACEMENT AND LOCATION OF IRRIGATION EQUIPMENT

The placement and location of irrigation equipment such as controllers, backflow devices, remote valve, isolation valves, quill valves and yard boxes for maintenance accessibility and student safety is a very important concern. The following are ideal locations for placement of the above irrigation equipment in order of most preferred location.

Sprinkler layouts for sports fields must be laid out for the individual sport; mass layouts are not acceptable.

9.4.4.1 Sports fields (Football, Baseball, Softball, Soccer field)

Install all equipment including the controller off the field of play in a fenced enclosure with valves such as remote valves, normally placed in a yard box, installed above the ground on a manifold system.

Place the hose quill valves for football fields up against the perimeter cement curb to field. For other sport fields install next to wall, fence or outer perimeter of grass field, preferably next to pavement.

Install Controller and backflow device as near as possible to a wall or fence, away from the field of play. Place the remote valves in marked yard box within 12” of fence, wall, and or outer perimeter of grass field, which is normally next to pavement. Provide an Isolation valve in a marked yard box prior to the group of quills.

Install remote valves in a minimum group of three to easily locate the yard boxes in future. Provide an isolation valve in a marked yard box prior to the group of remote valves.

9.4.4.2 General Physical Education Field

Install controller and backflow device as near as possible to a wall or fence, away from the field of play. Place the remote valves in marked yard box within 12" of fence, wall, and or outer perimeter of grass field, which is normally next to pavement.

Install remote valves in a minimum group of 3 to easily locate the yard boxes in future. Provide an isolation valve in a marked yard box prior to the group of remote valves.

9.4.5 SLEEVES

Pressure piping installed under driveways, heavy traffic thresholds or sidewalks shall be sleeved.

Sleeves shall be a minimum of 2 pipe sizes larger than the pipe it serves and include a tracer wire.

Do not use sleeves for long distances. Mainline piping must be center loaded to prevent movement due to expansion and contraction, which will cause the main line to break within the sleeve.

9.4.6 SPRINKLERS

Provide 100% head to head triangulated coverage or other approved 100% configuration.

Locate sprinklers with popup spray 12" away from buildings, 4" away from paved areas or parking stalls, and where trees will not interfere with spray pattern.

Reduce spacing in areas where winds during irrigation times may blow spray outside irrigation area.

Locate sprinkler lines on banks parallel to contours.

Sprinklers on fixed risers are not acceptable. All sprinkler heads shall be popup heads and installed with double swing joints.

All sprinkler spray heads shall have a built-in check valve to prevent drain down from the lowest head, including level irrigation systems.

Double swing joints shall be used at each sprinkler head location. Double swing joint shall be constructed with a Marlex elbow closest to the lateral line and a P.V.C. elbow closest to the connection with the sprinkler head.

Sprinkler head specifications: Hunter I-20 ADS and full heads, Hunter I-40 ADS and full heads, Rainbird 7005 Stainless Steel, Rainbird 5004 and 3500, and Toro 570.

Control valves shall be Superior 950 series, sized as needed.

An upstream shut off valve (S.O.V.) shall be placed ahead of each control valve. This inline S.O.V. shall be Nibco T-113 – IRR, all brass, sized as needed, with brass or galvanized nipples installed between the valve and the main line

On 2-inch pipe size and above, an appropriate size concrete thrust block must be utilized wherever a ninety (90) degree elbow or a "T" is inserted.

Provide drip irrigation for planter areas. Use 1/2" Netafim with inline pressure regulator and filter after the valve, in a valve box.

Manufacturers: Hunter, Rainbird or Toro.

9.4.7 CONTROLLERS

Controllers shall be provided with the following:

- Locate controller close to a building, wall or fence and accessible for use.
- Install in vandal resistant secured enclosure that prevents unauthorized access and control changes.

Manufacturers – Clock: CalSense ET2000e (or equivalent).

Provide connection to central control and monitoring computer via the school IT LAN cabling.

Provide Rain Sensor. Locate in area accessible to rain and not easily vandalized. Do not install under roof overhang. Enclose in a protective, lockable vandal-resistant enclosure.

Flow Sensor and Master Valve must be compatible with the controller manufacturer requirements.

Do not install manual control valves and quill valves on irrigation stations/zones using a flow monitoring system. Tie in before flow sensor.

Provide a hand-held remote control unit (1 per site).

Control wires shall be run in sleeves under hardscape.

9.4.8 REMOTE VALVES FOR LAWN AND PLANTER LOCATIONS

Remote valves serving planter areas shall be installed in marked yard boxes, located along the outer perimeter of planters they are serving. Place as close to the side walk or pavement as possible in order to easily access and utilize during operation without getting wet by sprinklers during operation.

Remote valves serving turf areas shall be installed in marked yard boxes, located along the outer perimeter of grass areas they are serving. Place as close as possible to the side walk or pavement in order to easily access and utilize during operation without getting wet by the sprinklers during operation.

When at all possible, install remote valves in a minimum group of three to easily locate the yard boxes in future. Provide an Isolation valve in a marked yard box prior to the group of remote valves.

9.5 TURF

Grass seed mixture shall be Stover Pro Sportsfield Supreme mix.

There shall be a minimum of six inches of tilled topsoil. The six inches of topsoil shall not contain any rocks or debris larger than 5/8”.

Random potholes shall be drilled to ensure that hard pan or bedrock does not exist within four feet of the ground surface.

Soil samples must be taken and approved by the District prior to planting of any grasses/ground cover.

Soil amendments shall be used, as required, to upgrade the soil to acceptable mineral and nitrogen content. Soil samples must be taken to ensure that the soil is acceptable to be planted.

Turf areas, landscaping, and hardscape areas shall be designed to reduce the amount of edging required.

Specify that the contractor must furnish proof of the type and composition of the seed mix supplied and planted.

Specify that the District will not accept any turf areas until all the different type grasses have filled in completely and have been exposed to normal summer time temperatures for 60 days with out suffering detrimental effects.

9.6 APPROVED PLANT LIST

9.6.1 GROUND COVER

Based on long experience with landscaping maintenance, the District has prepared a list of plants that are appropriate to the region, are not hazardous to students or staff, and require relatively little maintenance. Select plants appropriate to the site from "Approved Plant Lists" below.

Do not use ground cover (excluding grass). Plants selected must be drought-resistant, low-maintenance and selected from the following list:

Festuca	Fescue
Trachelospermum Jasminoides	Star Jasmine
Jasminum Grandiflorum	Spanish Jasmine (semi evergreen vine,10"-15')
Jasminum Multiprtiyum	African Jasmine
Ceanothus- Glorious	Point Reyes Ceanothus
Ceanothus Griseus Horizontalis	Yankee Point Carmel Mountain Lilac
Gazania	Gazania
Ajuga Reptans	Carpet Bugleweed
Laurentia Fluviatilis	Blue Star Creeper (2"x2')
Pittosporum Tobira	Wheelers Dwarf or Crème DeMint (2'x4')
Rhaphiolepis Indica	India Hawthorne

Callisteon	Dwarf Bottlebrush
Asparagus Sprenger	Asparagus Fern
Hemerocallis	Daylily
Nandina Domestica	Heavenly Bamboo
Nana Compacta	
Carrissa Macrocarpa	Natal Plum
Rosmarinus Officianalis	Rosemary
Viburnum Tinus	Laurustinus
Tecomaria Capensis	Cape Honeysuckle
Ilex	Holly
Loropetalum Chinensis	Loropetalum
Euonymus Japonica	Evergreen Euonymus (Variegated)

9.6.2 TREES

Use trees sparingly, to provide outdoor-area shade and aesthetic value to the school site. Do not use fruit bearing trees, fruitless mulberry trees, and palms. Trees must be single trunk varieties. Select trees from the the following list:

Alnus Rhombifolia	White Alder
Brachychiton	Bottle Tree
Chionanthus Retusus	Chinese Fringe Tree
Chitalpa Tashkentensus	Chitalpa
Fraxinus Velutina	Arizona Ash
Fraxinus Uhedi	Shamel Ash
Koelreuteria Bipinnata	Chinese Flame Tree
Pyrus Calleryana “Aristocracy”	Flowering Pear
Quercus Douglas	Blue Oak
Quercus Suber	Cork Oak
Sophoro Japovica	Japanese Pagoda Tree
Rhus Lancea	African Sumac
Sequoia Sempervirens	Coast Redwood
Purple Pony	Purple Plum

Cinnamomum Camphor	Camphor
Podocarpus Gracilior	Yew Pine
Pistache Chinensis	Chinese Pistache
Geijera Parvifolius	Australian Willow
Jacaranda Mimosifolia	Jacaranda
Koelreuteria Panniculata	Golden Rain
Pinus Ekidarica	Mondell Pine
Praxinus Oxycarpa	Raywood Ash
	Fantex