

TECHNICAL GUIDE
FOR NEW CONSTRUCTION
Including Additions and Remodeling

Modified Specifically for:

THE FACILITIES DEPARTMENT
FALCON SCHOOL DISTRICT 49

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Any deviation from this Guide requires the written approval of the Owner.

Source Disclaimer: This document was originally developed from a similar Technical Guide (~1990) developed by Jefferson County School District, Lakewood, CO. ESA has participated with many other schools in the state to refine that basic document, and ESA has worked with Falcon School District 49 to further develop the base document to meet the needs and specific requirements for Falcon Schools.

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APPENDIX 1

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DIVISION 1 - GENERAL REQUIREMENTS

I. INTRODUCTION

The purpose of this guide is to provide the Architect and Architect's Consultants with general design criteria based on the Owner's past experience. It should not be interpreted as limiting creative design, functional and economical solutions. However, any deviations from this guide will require written approval of the Owner. It is intended to establish continuity of quality throughout all school district buildings. Should any item contained in this guide be contradictory to current state of the art practices, it is the Architect's responsibility to inform the Owner of such item and provide information on alternatives.

All items specified to use in a school building, whether or not listed in this guide should provide a response to the following needs:

- ◆ Conformance with the spirit and letter of the Americans with Disabilities Act (ADA).
- ◆ Reduction of natural resource consumption including energy and water costs by means of insulation, energy-efficient windows and exterior door vestibules where practical, efficient light and mechanical systems, and incorporation of drought-resistant landscaping and artificial surfaces for exterior high-use areas.
- ◆ Reduction of maintenance cost by reducing the potential of vandalism and by increasing ease of service, replacement, and plant operation.
- ◆ Avoidance of the use of asbestos in any form.
- ◆ Address weather and natural characteristics of the site, especially wind, and soil conditions.
- ◆ Safety and security of those utilizing the building and site must be addressed in every aspect of the design. District security goals, processes, and systems must be incorporated into the initial project planning process.
- ◆ Develop a pleasing design in harmony with surrounding neighborhood features.
- ◆ Create economical design solutions, which lend themselves to flexible usage by staff, students, and the community-at-large.

The Architect should carefully analyze all products and construction methods to provide consistent quality and workmanship throughout the entire project.

II. DEFINITIONS AND RESPONSIBILITY

A. Owner/School District is the Falcon School District 49, El Paso County, Colorado. The School District's responsibility will include conferences with regulatory agencies to obtain information listed below. The School District will also file and follow up any applications that may be required for zoning or other variances. The School District will furnish the Architect with the following information:

1. Site Survey. Upon receipt of a specific request from the Architect, the Owner will select and contract directly with a Consultant to perform the work.
2. Soils Test. Upon receipt of a specific request from the Architect, the Owner will select and contract directly with a Consultant to perform the work.
3. Utility Extensions to Limit of Construction Contract. The Owner will obtain information regarding tap fees, meters and connections as well as the name of agencies having jurisdiction. The Owner will select Consultants as required for engineering

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assistance and will contract separately for work required, unless civil engineering is included in scope of Architect's services.

4. Off-Site Paving. The Owner will obtain requirements for paving outside of the school property lines, such as streets including curb and gutter. The Owner will select Consultants as required for engineering assistance and will contract separately for the work required. Architect shall verify with the Owner areas of paving not to be included in the building construction contract.
 5. Data and costs of any special site improvements.
 6. The "Owners Representative" is a specifically identified Manager or other individual whose responsibilities include project oversight. The Owners Representative specifically excludes Custodians, Principals, Teachers, Maintenance staff members and all other district staff not directly charged with administration of the construction contract.
- B. Architect. is the architectural firm employed by the Owner to complete Schematic Design, Design Development, Construction Documents and Construction phases of any new school or additions, and alterations to existing schools or other work as defined by contract.
- C. Safety Inspection Branch. The Colorado Division of Labor and Employment, Public Safety Section, has sole jurisdiction for approval of all school buildings in the district. The Architect is responsible for compliance with all applicable codes and coordination with the Public Safety Section Office.

Other codes and jurisdictions to be observed are:

1. State of Colorado and County Sanitation codes.
2. International Energy Conservation Code
3. International Plumbing Code
4. International Mechanical Code
5. Colorado Department of Labor and Employment regulations
6. ASHRAE 90.1-current version.
7. International Building Code
8. Colorado State Boiler Code
9. Colorado Department of Health Regulations
10. NFPA 5000 Standards
11. International Fire Code
12. Local Codes or standards as applicable; including Fire, utility regulations, etc.
13. EPA Storm Water Phase II regulations

14. Americans with Disabilities Act

1. Contractor shall be responsible for obtaining all permits such as sidewalk permits as required by the City in which the project is being constructed, except that City building permits are not required (see "C" above).
2. General Contractor shall provide breakout of cost for all work accomplished within existing buildings for any project, to assist in determining Architect's fees.
3. Wherever any soil sterilization is accomplished, Contractor shall assume responsibility of damage to other areas, both on and off school property.
4. See General Contract Conditions for Falcon School District 49 for balance of requirements. Supplementary conditions may be developed for each project, as required.

A. Exterior.

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10. For access from one roof level to another use ladders conforming with all code requirements.
11. Provide permanently affixed ladder with hatch opening to roof. Stairs are preferred.
12. Provide natural light in all principal stairways. Keep windows high to reduce glass breakage.
13. To reduce vandalism, avoid using windows or window walls in areas that are screened from public streets.
14. Glass below 3'0" from floor level is discouraged.
15. Incorporate use of soft landscaping materials ("breeze") and avoid use of stones, boulders, and similar materials in landscapes. Mulches must be established to resist wind erosion, and should avoid use of mats.

B. Interior.

1. Masonry or other durable material partitions are desirable in all heavy use areas - gymnasium, all-purpose rooms, corridors, toilets, and kitchen.
2. Use bull-nose block for all vertical corners exposed on unit masonry partitions.
3. Provide abrasive nosings on all stairs and non-slip easily maintained surface on all stairs and ramps.
4. Rise and run of stairs shall be properly proportioned and shall meet tolerance requirements of building codes. Stair risers in elementary schools shall not exceed 6 1/2".
5. Head clearance in stairways shall be not less than 8' measured in any angle from nosing.
6. Use stairs or ships ladders for access to main roof, mechanical decks, crawl space, etc. Try to avoid use of vertical ladders.
7. Provide non-slip surface for floors in shower and locker rooms.
8. Ceiling height of 9'-0" minimum for secondary schools including K-8 and 8'-0" in elementary schools is desirable for all student-occupied spaces. Requests for exceptions will be reviewed individually.
9. Color selections for floor materials should, whenever possible, be made from the middle of the color value range to reduce cleaning maintenance costs. Dark colors should be avoided.
10. Crawl spaces, if required, shall be 5' minimum height and be ventilated by a gravity system. High radon readings or the presence of dampness may require mechanical ventilation.
11. Provide acoustical separation of music rooms from each other and from the rest of the building.

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12. Building should be designed with all possible utilities overhead in ceilings and with adequate space for them.
13. Mechanical access for terminal heating, VAV, and similar space conditioning systems should be located in hallways (not within the classroom or office) whenever possible for Maintenance access without disrupting the occupied area.
14. Design team shall coordinate with Owner and Telephone Vendor to provide adequate space for voice over IP racks, spare, and space conditioning requirements.

C. Preferred Finishes and Materials.

1. Interior corridors and gymnasium wainscot.
 - a. High School/Middle School/K-8 – Concrete block with epoxy or enamel finish or structural glazed tile.
 - b. Elementary School – Painted impact-resistant gypsum board with “tile or concrete block wainscot”. (Avoid ground face or split face block at either interior application.)
2. Classroom Walls.
 - a. Painted gypsum board.
 - b. Vinyl wall covering over gypsum board only with Owner approval.
3. Kitchen Walls.
 - a. Glazed tile.
 - b. Epoxy on concrete block.
4. Restroom Walls.
 - a. Glazed tile, full height or wainscot.
 - b. Epoxy on concrete block.
5. Exterior Walls.
 - a. Concrete block, integral color.
 - b. Brick masonry.
 - c. EIFS only on walls above ground level.

IV. ENGINEERING

- A. Civil, Structural, Mechanical, and Electrical design of the building shall be by registered professional engineers specializing in that type of engineering.
- B. Seismic design shall be in accordance with UBC Zone 1 requirements.
- C. Live loads, I.M.C. - The Building Code currently calls for 125 psf for stacks and 60 psf for reading rooms. Use minimum 125 psf for floor live load in open concept I.M.C. to insure future safe usage with possible stack location changes. Comply with current applicable codes.
- D. Control differential movement between steel and masonry building components to minimize cracking of masonry, by the use of isolation and control joints and by conservative structural design of all building components.

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- E. Design all floor structures to accommodate all planned or contemplated future partitions.
- F. Give special attention to points of connection between new and existing structures. Detail all construction requirements.
- G. Coordinate location and structural requirements for all depressed floor areas - architectural to structural.
- H. Detail all structural conditions required to provide access to existing or new boilers for future replacement. Ensure adequate access to maintain all components of all air handling systems, including replacement of the unit. This includes access to filter banks, adequate room for the replacement of coils and heating sections, and other maintenance space requirements established by the equipment Manufacturer.
- I. Dowel all concrete walks and platforms adjacent to buildings at exit doorways to the foundation wall to minimize vertical movement.

V. DRAWINGS

The sequence and listing of all required design and construction documents is shown on Form A16, Design Phase Requirements. Requirements may be revised as required for individual projects.

- A. Design development drawings approved by the Board of Education shall be followed as closely as possible in the final design. Where changes are found to be necessary to improve functional areas or accommodate mechanical or electrical equipment, the approval of the Facilities Department shall be obtained before any revisions are made.
- B. Drawings shall be complete and fully coordinated among the various trades and with the specifications. The Architect is responsible for coordinating the format and content of the architectural, structural, mechanical and electrical drawings.
- C. Drawings shall be on 24"x36" or 30"x42" Mylar sheets. AUTOCAD 2002 (or most current) drawings should be provided at each stage of design and for As-Builts.
- D. All final drawings and the cover sheet of the specifications shall carry the same date and name of the projects.
- E. Final sets of drawings and specifications shall be numbered consecutively and a record shall be kept by the Architect, of the distribution, of all sets, during the bidding period.
- F. A north arrow shall be shown on each plan sheet. All drawings (architectural, structural, mechanical, and electrical) shall have the same orientation.
- G. Standard symbols shall be used on all drawings. Include a standard symbol legend on the first sheet of architectural, structural, mechanical and electrical drawings. Room and door numbering systems shall be used and shown on legends. All rooms, spaces, and corridors shall be given a number on the drawings. Column lines shall be shown and identified on all plan drawings, including structural, mechanical, and electrical. Attention should be given to the existing room numbering schemes and extension to the numbering system should be a logical sequence that anticipates future additions.
- H. General notes may be used on drawings to reduce the amount of repetitive drafting, provided that clarity is not lost.

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- I. Keep all lettering neat. Avoid crowding of details so that drawings will be readable if reduced in size.
- J. Dimensions shall be complete, accurate, and fully coordinated. Dimensions shall be laid out to points easily located in the field. Additional costs resulting from dimensional errors are chargeable to the Architect.
- K. Suggested scales for architectural work:
1. Floor Plans, Exterior and Interior Elevation,
 Building Sections: 1/8" or 1/4" = 1'-0"
 Roof Plans 1/8" or 1/16" = 1'-0"
 Wall Sections 1/2" or 3/4" = 1'-0"
 Stair Sections 3/8" or 1/2" = 1'-0"
 Details 3/4" = 1'-0" or larger
 2. The overall floor plans may be drawn 1/8" = 1'0" scale. In this case, detail plans at 1/4" = 1'0" should be drawn of all-important areas to show fixtures, equipment and complete dimensions.
 3. If the plan for a single floor is shown on more than one sheet, each sheet should have a key plan in an obvious location with a shaded portion to show the area detailed on that sheet. Key plan should also be used on structural, mechanical and electrical sheets.
 4. Mechanical Plans should include a Standards Table indicating design conditions for all HVAC equipment and including thermal loads and other energy-related parameters used in the selection and sizing of the HVAC equipment.
- L. Order and/or conduct a Site Utility Locate to establish and confirm existing utilities. Show all known underground utilities on site development plan and caution Contractor to avoid damage during construction. Show locations of all soil test holes and log of subsurface information at each hole on site plan sheet.
- M. The Design Team is responsible for determining requirements for local utility providers including submittal documents, taps, fees and licenses, meters, pressures, etc. The Design Team will determine required meter locations, requirements for separate taps or combined taps, and other specific requirements of all local utility providers for each project.
- N. On the first architectural plan sheet or on the cover sheet, include a complete area breakdown including the total square foot area of each floor and each individual room. Indicate Type of Construction and Occupancy Group for the building or each part if different, on the first architectural plan sheet. If an addition, show existing and new square foot area. Include occupancy capacities for each room.
- O. Show on the first structural drawing under "General Notes" the live loads used, concrete and steel stress information, foundation, column, and masonry notes. Include a note to the effect that earthquake seismic loads for Zone 1 have been used in the design.

VI. SPECIFICATIONS

- A. Format.

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1. The primary purpose of the specification is to clearly state the minimum acceptable requirement for all materials and equipment incorporated into the project. Materials and equipment which are based on Federal Specifications, ASTM Standards, National Bureau of Standards, or other organizations are to be identified by specific type, grade, and class. If such references are used, copies of the standards shall be made available to the Owner and Contractor, by the Architect.
2. Correlate the specifications with the bid form, the General Conditions, and the drawings. Crosscheck between general, architectural, structural, mechanical, and electrical parts of the specifications.
3. Specifications shall be specifically tailored to this project.
4. Unless notified to the contrary, this project will be bid as a single contract. Avoid references to Mechanical Contractor, Electrical Contractor, etc. Refer only to the "Contractor" or to "subcontractors."
5. Cover shall be printed so the project name and address match exactly the same information on drawing title blocks and in bid documents. Date on specifications must be same as date on drawings.
6. Final copies of specifications shall be on 8 1/2" x 11" paper; assembled and bound. Provide all specifications in electronic format (Word or PDF).
7. CSI standard format shall be used for all technical divisions of the specification and any required addenda.
8. A table of contents shall be provided at the front of the specifications and showing division and section numbers and pages.
 - ◆ Paragraphs and subparagraphs should be numbered and lettered for easy reference.
 - ◆ Sections of the specifications shall be included in the following order:

Cover Sheet	Prepared by Architect
Title Sheet	Prepared by Architect
(Same information as on cover sheet)	
Table of Contents	Prepared by Architect
Bidding Information	Furnished by District
Advertisement of Bids	
Instructions to Bidders	
Special Notice to all Bidders	
Contract Forms	Furnished by District & Architect
Base Proposal	
Bid Bond	
Notice of Award	
Agreement	
Contractor's Performance Bond	
Labor and Materials Bond	
Notice to Proceed	
Notice of Contractor's Settlement	
General Conditions	Prepared by Architect
Supplementary General Conditions	Prepared by Architect
Technical Sections	Prepared by Architect

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- ◆ In the outer upper or lower corner each page of each technical section shall be numbered with the number of the division and page, or the Section number and page.

9. Shop drawings and product data shall be called for as applicable under each division of the specifications.
10. Wherever possible, include a minimum of two equal products by manufacturer and product name for each material, product or equipment item listed in the specification.

B. General Conditions.

1. Use AIA documents as a standard.
2. Edit all specification divisions to eliminate conflicts with the standard General Conditions.
3. Any changes from the standard General Conditions required to meet the requirements of this project shall be included in the Supplementary General Conditions and all such changes shall be submitted in writing to the District for written approval.

VII. ALTERNATES

List all alternates (if any) and provide a concise description of each. State whether alternate is an add or deduct from the base bid amount. (Owner must approve all alternates.)

VIII. COST ESTIMATES

CSI Standard Divisions and Sections shall serve as the basis for cost estimates as required by Form A16, Design Phase Requirements. Line item cost entries shall be developed for each section utilized in the accompanying Design Development and Construction Document phases.

<<<<END OF DIVISION 1>>>>

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DIVISION 2 - SITEWORK GENERAL

I. GENERAL

- A. Drainage and Wind Protection. A drainage plan for the site shall be prepared by an Engineer experienced in such work and conforming to local regulations. Particular attention should be given to surface and ground water including seasonal fluctuations, and to physical properties of construction materials with regard to expansion and contraction. Past experience has indicated that adequate attention has not always been given to the above-mentioned problems. The School District has concerns about high winds, including loss of roofing and roof gravel, and building damage due to soil movement. The site must maintain EPA Storm Water Phase II standards and adhere to the district Phase II Plan commitments.
- B. Soil Conditions. Due to economies involved, the School District has the premise that, in general, the ground floor slab of all structures will be located on compacted fill, and that fill will developed from on-site materials insofar as possible. In cases of expansive or poor soil, structural floor slabs are to be used, where recommended by the Soils Engineer. In cases where mechanical equipment is located above ground floor slab, provide stable support to eliminate vibration.
- C. Vehicular Traffic. Safety at all schools and safety on playgrounds is of first consideration. Auto, truck, and bus traffic patterns should be designed so as not to become a hazard to the students. Where possible, separate bus drop-off areas from auto drop-off areas. All signs, signals and markings on school property shall conform to the "Uniform Traffic Control Device Manual," published by Colorado Department of Highways, Planning and Research Division. Service traffic of all types shall be held to an absolute minimum on school grounds. The site should be developed so that student traffic does not cross or go through service traffic lanes.
- D. Playgrounds. For protection of children, avoid wherever possible: steep slopes, open drainage swales and retaining walls. Provide a means to exclude autos, buses, and motor scooters from all playground areas, and provide protected access ways at normal lines of pedestrian traffic. Prohibited equipment includes merry-go-rounds and tube slides. Shading is required. For preschool areas, comply with the Colorado Department of Health and Human Services requirements.
- E. Utilities. For all projects, water, gas, electric, data, communications, fire alarm, security and sewer should extend to and be capped at face of building to allow for connection of temporary classrooms. Such temporary classrooms should not be located in areas of probable additions. Show area for location of temporary classrooms (24' x 60' typical size and approximately a 150' x 150' pod complex) on DD submittal and final construction documents. For schools that are not built to ultimate capacity in the initial phase, size on-site utilities to allow for ultimate capacity. Provide for enclosures at meters, transformers, and remote readers, as required by utility company. Separate water metering is required for irrigation systems and cooling towers.
- F. Fire Lanes. Conform to local Fire Department rules for prevision of any paved or unpaved lanes for fire truck access and for temporary fire lanes to be maintained during construction. Include confirmation of fire hydrant locations along with other fire safety requirements.
- G. Visual Screening. Include visual screening, where possible, of the delivery, transformer, meters, and trash dumpster areas, in harmony with the building design.

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II. DESIGN, GRADING AND EXCAVATION

- ◆ Contractor must order utility locates for all underground work.
- ◆ All site work must comply with U.S. EPA MS-4 Stormwater Regulations.
- A. Design Analysis. A preliminary and final design analysis of site engineering should be submitted to the governing agencies and copied to the Facilities Department. At a minimum show pertinent calculations for the following:
 - 1. Surface Drainage. Detention areas and discharge points.
 - 2. Subsurface Drainage (if required), footing drains, underfloor drainage system.
 - 3. Estimated water and sewer demands used in sizing pipe connections to city mains.
 - 4. Include a site plan showing existing and finish grades for entire site.
 - 5. All other requirements of the local jurisdiction.
- B. Site Grading.
 - 1. All finish grades should be designed to provide positive drainage away from the buildings and into approved drainage systems.
 - 2. The design of surface drainage should be based on water run-off using the Rational Method:
 - a. Maximum hourly rainfall in inches to be expected in ten years or as required by each city's wastewater control division.
 - b. Ratio of runoff to rainfall:

Pavement and roofs	0.90*
Turf area	0.40*

*Unless stipulated otherwise by local jurisdiction
 - 3. The following slopes are desirable in the design of finish grades:
 - a. From outside face of building wall to a distance of 10 feet: 3% (minimum)
 - b. Parking areas: 1% minimum; 3% maximum
 - c. Playground areas: 1% to 2%
 - d. Lawn areas: 25% maximum
 - 4. Where retaining walls are necessary, they should be held to a minimum height.
 - 5. Whenever possible roof drains should be conducted through concealed pipes to the city storm sewer system. If a storm sewer is not available, consult with the city's wastewater management division for acceptable methods of surface drainage.
 - 6. Give consideration to finish site materials other than grass on north side of buildings, berms, and other locations where maintenance is costly and difficult.
 - 7. Avoid berm slopes, which make rider-driven machine mowing difficult.

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8. Parking lots should be designed for positive drainage. Drain toward curbs where possible so that water will collect out of traffic patterns.
 9. Plantings, trees, and edges should be regional native plants; simple and capable of minimum maintenance and should be drought-tolerant. Trees and plantings should have a separate watering zone.
- C. Excavation. Where existing sites were used for residential purposes prior to acquisition by the School District, basement, or foundation structures may be encountered during excavation operations. All such obstructions should be removed as required for the proper construction of this facility, as part of the Contract. The Architect should include sufficient information on the drawings to indicate locations of previous construction.
- D. Drilled Caissons. (If required)
1. The Owner will employ a soils engineer to provide continuous on-site observation of the pier drilling, steel reinforcement, and concrete placement
 2. The estimated elevation of the pier bottoms shall be shown on the drawings. The soils engineer will verify and approve depth of all holes prior to concrete placement. If actual site conditions differ from those indicated by the drawings, the unit cost overrun and underrun figures indicated on the bid form will be applied to establish any extra due to the Contractor or credit due the Owner due to changes in depths of piers. Unit prices for pier overruns shall not exceed underruns by more than 20%. Adjustment in the contract price will be made by change order upon completion of drilled pier operations.
 3. The Contract will include drilling, de-watering, and casing where required.
 4. Compaction Standards. The Owner will employ a soils engineer to assist in obtaining required compaction standards. Consult the soils investigation report for suggested compaction standards for this project.
- F. Miscellaneous.
1. Loading Dock. Loading dock facilities for middle and senior high schools shall consist of a platform raised 4 feet above the service drive to allow truck equipment with power gates to unload conveniently. Loading facilities for elementary schools shall consist of a concrete slab raised 6" above the service drive unless site conditions are such that a 4' high loading dock can be conveniently provided without excessive additional cost. Canopies over loading docks are to be high enough to allow clearance for 11'-6".
 2. Where areaways occur, provide with curb at least 6" above grade level. Opening shall be covered with steel grating.
 3. Provide a 3' wide concrete apron adjacent to the outside wall of the buildings wherever lawn or planting areas occur.
 4. Repaving of cuts through existing concrete or asphalt by the appropriate utility provider for gas and electrical service should be included in the work under the construction Contract.

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III. SITE IMPROVEMENTS

A. Concrete Walks, Curbs, and Gutters.

1. Existing concrete walks, curbs, and gutters outside property lines shall be protected and if damaged shall be replaced by the Contractor in accordance with requirements of the local jurisdiction in which damage occurs.
2. Outside of property lines, walks, curbs, gutters, aprons, etc., should be constructed in accordance with each local jurisdiction's requirements.
3. Within property lines, pedestrian walks should be constructed of 4" thick, 3000 psi concrete with fiber-mesh reinforcement.
4. Concrete for vehicular use shall utilize appropriate welded wire mesh reinforcement and the thickness shall be 6". All concrete design mixes shall be submitted for review and approval.
5. Control joint should be provided in exterior concrete flatwork as follows:
 - a. Between building and walks.
 - b. Wherever concrete is confined, for example, from building to curb.
6. If at all possible, avoid any outside steps, or make additional provision for handicapped ramps.

B. Playground Areas.

1. Comply with Consumer Protection Safety Commission (CSPC) rulings and standards for playground equipment. Review current standards for mats, safety surfaces and drain tiles.
2. Comply with Americans with Disabilities Act (ADA) standards for playground access.
3. Do not use metal slides, tube crawlers, merry-go-rounds pea gravel or river rock in playground areas.
4. Provide 12" deep safety surfacing with rubber mats under swings and at outlet of slides.
5. Playground equipment such as basketball backstops, softball backstops, and tetherball posts may be included in the construction contract. Play structures, swings, and slides are customarily planned and purchased by School District. Exact requirements will be defined on an individual project basis.
6. In paved playground areas requiring installation or tetherball posts or any other posts, specifications should require that paving be completed before poles are installed.
7. Paving shall comply with State of Colorado Department of Highways, Standard Specifications for a Road and Bridge Construction. Edges shall abut concrete curbs. If paved area is elevated from surrounding grounds, provide a positive means of carrying the run-off from the area so banks are not eroded. Refer to section IV – asphalt paving.
8. Provide access to all paved areas for sweepers and snow removal equipment.

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C. Vehicular Parking Areas.

1. Automobile parking areas should be paved in accordance with state standards.
2. Painted striping designation of parking stalls including handicapped will be a part of the construction contract and should be shown on the site plan drawing.
3. Layout of parking spaces should be based on 9' x 20' stalls and 22' aisles. Provide adequate spaces and curb cuts and ramps designed for the handicapped.
4. Precast or recycled concrete or recycled plastic wheel stops, where necessary, should be furnished and installed as part of the contract, but avoid where possible due to difficulty of snow removal.
5. Provide an area for bicycle parking at a suitable location. Verify with Owner whether fencing is required.

IV. ASPHALT PAVING

- A. Tests and Testing. All materials identified at the start of the job as those to be used on the project by the Contractor are subject to testing during construction by an independent testing laboratory. All testing in this section shall be in accordance with the General Conditions of the Contract.

The Owner will employ a Soils Engineer to control excavation and fill for subgrade beneath pavements and to verify base course materials, placement methods, and compaction.

- B. Inspection. All work performed under this contract is subject to the inspection and approval of the Owner and Architect. Specific inspections should be required and called for by the Contractor on the following elements of work:

Protection of adjacent property
Staking and establishment of elevations
Establishment and compaction of subgrade
Placement and compaction of base course, primecoat, and bituminous wearing surface
Final inspection

The Contractor should obtain approval of each element of work listed above in sequence of its completion and before proceeding with the next item. Failure to secure approval of these inspections in sequence of completion shall be just cause for the removal of all elements not previously approved.

- C. Compaction. The subgrade, whether it is undisturbed earth, fill or base course, should be compacted as required by the soils report and as defined under the Earthwork section of the specifications. In no case, shall it be less than 95% of maximum density. The entire area on which the paving is to be placed should be investigated by the Contractor with particular reference to the compaction required.
- D. Pavement Construction. The necessary work items to construct the pavement structure, including preparation of subgrade, base course, bituminous wearing course, etc., shall be designed and specified to conform with, at minimum, the State of Colorado Department of Highways, Standard Specifications for a Road and Bridge Construction.

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Speed bumps are prohibited.

- E. Clean-Up. Immediately after completion of the work, the entire site shall be cleaned of any debris and excess paving materials, to the complete satisfaction of the Owner.
- F. Guarantee. In addition to guarantees as specified elsewhere, the Contractor shall repair or restore to first class condition any portion of the paving in which creeping, shoring, cracking, softening, settling or other defects that are due to improper placing or defective materials appear or become apparent within one year from date of acceptance. All workmanship and materials necessary for any repairs shall be in complete accordance with the requirements of these specifications for the original work.

IV.V. FENCING

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- A. Construction Fence. Existing sites (adjacent to existing schools): Chain link or other fencing approved by Facilities Department for the Contractor's use around the construction site to isolate school activities from the construction area will be furnished, installed and removed by the Contractor. Verify location before installation.

New Sites: Construction fencing should be furnished and installed to protect contractor's materials and equipment, and to control access to the construction area. Consult with the Architect and Owner for location before installation.

- B. Permanent Fence - Requirements for permanent fencing for playground, etc., vary from project to project. Location and extent of fencing will be determined as a part of the site development.
- C. Suggested Fencing Materials. All fence materials **shall** be steel, galvanized by the hot dip process.
 - 1. All posts should be Schedule 40 pipe.
 - 2. Fabric: 9 gauge wire, 2" mesh, knuckled top and bottom. Furnish one piece fabric width for fencing up to 12' high. Place fabric on outside of line posts.
 - 3. Line Posts: 1 1/2" nom. (1.9" O.D.) space at 10' O.C. unless shown otherwise.
 - 4. Terminal Posts: 2" nom. (2.375" O.D.) for end, corner and pull posts.
 - 5. Gate Posts: 2 1/2" nom. (2.875" O.D.) for single gate. 3" nom. (3.5" O.D.) for double gates.
 - 6. Top Rail: 1 1/4" nom. (1.66" O.D.) manufacturer's longest lengths, with 6" long expansion type couplings at each joint. Provide means to securely attach top rail to each post, such as welding.
 - 7. Center Rail: 1 1/4" nom. (1.66" O.D.) locate between each terminal post (end, corner and gate) and the nearest line post. Attach securely to each post.
 - 8. Truss Rods: 3/8" dia. rod with anchor and turnbuckle fittings. Install diagonally from top of all terminal posts to bottom of nearest line post and diagonally each way in all gates.

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9. Tension Bars: Minimum cross section 1/4" x 3/4," one piece lengths equal to fabric height.
 10. Tension Clamps: 14 gauge x 1" spaced at 15" O.C. maximum.
 11. Tension Wire: 9 gauge wire. Install entire length at bottom edge and 2' above bottom edge of fabric. Wire to be continuous between terminal posts.
 12. Fence Fasteners: 12 gauge wire. Space 12" O.C. on line posts and 24" O.C. on rails and braces.
 13. Post Tops: Weather tight closure cap with opening for top rail, one cap for each post.
 14. Gates, Swinging:
 - a. Frames: 1 1/2" nom. (1.9" O.D.) for all perimeter members and intermediate members if perimeters are over 8' apart. Frames shall be welded and joints painted with zinc based paint.
 - b. Fabric: 9 gauge wire, 2" mesh, knuckled top and bottom, attached to frame with tension bars and clamps same as for fence.
 - c. Hinges: Malleable iron, non-lift-off type, 180° swing, one pair for each gate to 6' height. Provide 1 1/2 pair for gates over 6' height.
 - d. Latches: Fork type for single gate, plunger-bar for double gates. Operation either side, integral padlock eye, plunger-bar strike set in concrete.
- D. Recommended Installation Procedure. Fence installation should not proceed until finish grading has been completed in areas where fence is to be installed.
- All post holes should be 9" diameter and excavated to 30" depth. Post spacing should be measured parallel to the ground. Posts should be set in min. 2500 psi concrete 24" below finish grade. Vibrate or tamp concrete around each post. Check each post for vertical and top alignment and maintain in proper position until concrete has set.
- Install fabric to maintain approximately 2" between bottom selvage and finish grade.
Install tension wire by weaving through the fabric or tying to the fabric at 24" O.C. Tie tension wire to each post. Twist all tie wire at least 2 full turns and bend back to prevent hazard.
- Attach all hardware to provide security against removal or breakage.
- When complete all fencing shall be plumb and true to line.
- E. Gas Meter Enclosure. Provide a fenced enclosure with gate and top around the gas meter, in accordance with local utility provider requirements.

VI. LANDSCAPING

A. Materials.

1. Analyze the organic content of the existing soils and recommend amendments if necessary. The Owner will contract separately for these services.
2. Specify Organic content of soils to be used for the project
3. Subsoils. Imported materials for landscaped areas shall be specified as to acceptable organic content.
4. Topsoil. Lawn areas should have a minimum 4" topsoil installed and should be fine graded to finish elevations. Sodding and landscaping will be included in the contract

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unless otherwise directed. Avoid narrow grass areas – less than eight (8') feet wide and use of plantings in narrow islands, etc. Refer to local regulations and guidelines in effect for drought-resistant plantings. Turf areas should be limited to play areas and fields. Drought-resistant landscape designs should apply to all other areas. Consider the cost and use/benefits of artificial turf products for playgrounds, play areas, and fields.

5. Seed Counts. Review turf seed count specifications with Owner prior to
6. Building Perimeter. Consult with Owner regarding the use of mulches, breeze, landscape finish materials and drought-tolerant plantings. If mulches are used, do not specify matting materials. Mulches shall be at least 4" deep (below grade level).
7. Aggregates. Breeze material is acceptable for landscaping. Rocks shall be encased in concrete or over 100# each.

VII. IRRIGATION SPECIFICATIONS

A. Materials.

1. General. All materials throughout the system shall be new and in perfect condition. After award of the contract and prior to beginning work, the Contractor shall submit for approval six copies of the complete list of materials that he proposed to install. Quantities of materials and equipment need not be included. No deviations from the specifications shall be allowed.
2. Separate irrigation meters are required. Contractor shall coordinate with the Architect and Owner to install separate metering devices acceptable to the local water provider to distinguish irrigation water consumption from general building construction.
3. Plastic Piping. All main line pipe 3" and smaller shall be Schedule 40, Type 1120-1220 polyvinyl chloride (PVC) pipe and shall conform to CS-256-63.
4. Plastic Fittings. Schedule 40, polyvinyl chloride (PVC) standard weight as manufactured by Sloane, Lasco, or approved equal.
5. Solvent Cement. Compatible with PVC pipe and of proper consistency.
6. Sprinkler Head Risers. Schedule 40 galvanized iron pipe or Sch. 80 PVC for riser. Pipe shall be cut in a standard pipe cutting tool with sharp cutters. Ream only to full diameter of pipe and clean all rough edges or burrs. Cut all threads accurately with sharp dies. Not more than three (3) full threads shall show beyond fittings when pipe is made up. Assemblies shall be as detailed.
7. Automatic Controllers. The sprinkler controller shall be manufactured by Automate Logic and shall be an extension of the districts' building automation system.. Consult with Owner regarding the system specifications.
8. Remote Control Valves. The automatic remote control valve shall be a globe pattern electrically activated, 150 psi rated. Cylolac and glass filled nylon plastic construction. Diaphragm shall be of polyurethane material. Solenoid shall be 3.5 watt, 24 volt A.C. with waterproof-molded coil capable of being removed from the valve with turning coil and twisting wire. Valve shall be equipped with a hand operated flow control stem, a

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manual bleed plug, and all internal parts shall be serviceable from top of valve without removing the body from the line. Pressure loss at 30 GPM shall not exceed 7.0 psi.

9. Control Wires. 24 volt solid wire UL approved for direct burial in ground. Minimum wire size: 14 gauge.
10. Sleeves for Control Wires. Under all walks and paving and where indicated on drawings, PVC 1200-160 psi plastic pipe or galvanized heavy wall steel conduit.
11. Sprinkler Heads. Radius 45' to 67': The full and/or part circle sprinklers shall be gear driven rotary, in-ground type and designed with an integral check valve for control of line drainage. Water distribution shall be via two (2) nozzles mounted in a 1 1/2" diameter stainless steel nozzle turret. The dual nozzles shall elevate 2-3/8" when in operation. Retraction shall be achieved by a heavy-duty stainless steel retract-spring. The sprinkler shall have a riser seal and wiper.
 - a. Rotation shall be accomplished by sealed oil packed gear assembly isolated from the water supply.
 - b. The drive assembly and nozzle turret shall move up and down as an integral unit.
 - c. The sprinkler housing shall be of high impact molded plastic with a 1" IPS connection. The sprinkler shall have a large strainer so as to prevent nozzle clogging.
 - d. The sprinkler shall be so constructed that drive assembly, screen, and valve are accessible through the top of the sprinkler without disturbing case installation.
 - e. The sprinkler shall be manufactured by Rainbird, Buckner, or approved equal.
 - f. All heads in the play field areas shall have rubber caps.
12. Sprinkler Heads. Radius 4' to 15': The sprinkler shall be of the fixed spray type designed for in-ground installation.
 - a. The nozzle shall be comprised of one orifice at two radius ranges and shall be adjustable from full on to full off. The nozzle shall elevate 3 inches when in operation. Retraction shall be achieved by a heavy duty stainless steel spring. The nozzle piston shall have a smooth external surface operation in a resilient guide. A riser wiper shall be included in the sprinkler for continuous operation in the presence of sand and other foreign material.
 - b. Coverage shall be either full or part circle. The part circle coverage shall be available in arcs of 90°, 120°, 180°, 240° and 270°. Also included shall be special patterns including an end strip and center strip nozzle configuration. Nozzle delivery shall be such as to allow part-circle patterns to match full circle patterns in precipitation rates. The body of the sprinkler shall be constructed of non-corrosive heavy duty Cylolac. A filter screen shall be in the nozzle piston. All sprinkler parts shall be removable through the top of the unit by removal of a threaded cap.
 - c. The sprinkler shall be manufactured by Rainbird, Hunter, Toro, or approved equal.
 - d. All heads in play field areas shall have rubber caps.
13. Shrub Bubbler. The sprinkler shall be of the flood bubbler type. The sprinkler shall be constructed of non-corrosive heavy duty Cylolac. Flow shall be adjustable by means of a stainless steel throttle screw on top of the unit. Serviceable screen shall be included to prevent foreign material from entering sprinkler. The sprinkler shall be manufactured by same manufacturer as balance of sprinkler heads. This sprinkler shall not be placed on risers above ground level.

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14. Service Saddles. Shall be Smith-Blair double strap, all bronze.
15. Quick Coupling Valves. Shall be as noted on drawings.
16. Backflow Preventer. Shall be compatible with local plumbing codes.
17. All irrigation systems shall be separately metered.

B. Installation.

1. Excavating and Trenching:
 - a. Trenches shall be made wide enough to allow a minimum of 6 inches between parallel pipe lines. Trenches for pipe lines shall be made of sufficient depths to provide the minimum cover from finish grade as follows:
 - (1) 18" minimum cover over main lines.
 - (2) 12" minimum cover over control wires from controller to valves.
 - (3) 12" minimum cover over lateral lines to heads.
 - b. Maintain all warning signs, shoring, barricades, flares and red lanterns as required by the Safety Orders of the Division of Industrial Safety and any local ordinances.
2. Pipe Line Assembly:
 - a. Install remote control valves where shown and group together where practical; place no closer than 12 inches to walk edges, buildings, and walls.
 - b. Plastic pipe and fittings shall be solvent welded using solvents and methods as recommended by manufacturer of the pipe, except where screwed connections are required. Pipe and fittings shall be thoroughly cleaned of dirt, dust, and moisture before applying solvent with a non-synthetic bristle brush.
 - c. Pipe may be assembled and welded on the surface. Snake pipe from side to side of trench bottom to allow for expansion and contraction.
 - d. Make all connections between plastic pipe and metal valves or steel pipe with threaded fittings using plastic male adapters.
 - e. Main line shall be graded to drain without using a pressure system to blow out lines if automatic drain valves are utilized. Coordinate with Owner for use and layout of automatic drain valves.
 - f. Automatic drain valves should be used where lateral line will not drain back to main line.
 - g. Drain valves shall be accessible without digging.
 - h. Control valves shall be grouped in one location where possible and installed in valve boxes for protection and access.
 - i. In-line anti-siphon check valves shall be installed to prevent drain down of large portion of the system to a single point.
3. Sprinkler Heads:
 - a. Install all sprinklers as detailed on drawings using PVC swing joints.
 - b. Use pipe joint compound on galvanized iron fittings.
4. Closing of Pipe and Flushing Lines:
 - a. Cap or plug all openings as soon as lines have been installed to prevent the entrance of materials that would obstruct the pipe. Leave in place until removal is necessary for completion of installation.
 - b. Thoroughly flush out all water lines before installing heads, valves and other hydrants.

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5. Hydrostatic Tests:
 - a. Center load piping with small amount of backfill to prevent arching or slipping under pressure.
 - b. Apply a continuous and static water pressure of 60 psi when welded plastic joints have cured at least 24 hours and with the riser capped as follows:
 - (1) Main lines and submains to be tested for 12 hours.
 - (2) Lateral lines to be tested for 2 hours.
 - c. Repair leaks resulting from test.
6. Automatic Controllers. Connect remote control valves to controller in a clockwise sequence to correspond with station setting beginning with Stations 1, 2, 3, etc.
7. Automatic Control Wiring:
 - a. Install control wires, sprinkler mains and laterals in common trenches wherever possible.
 - b. Install control wires at least 18" below finish grade and lay to the side and below main line. Provide looped slack at valves and snake wires in trench to allow for contraction of wires. Tie wires in bundles at 10' intervals.
 - c. Control wire splices will be allowed only in runs more than 500 feet. Connections shall be as detailed.
 - d. All wire passing under existing or future paving, construction, etc., shall be encased in plastic or galvanized steel conduit extending at least 12" beyond edges of paving or construction.
8. Backfill and Compaction:
 - a. After system is operating and required tests and inspections have been made, backfill excavations and trenches with clean soil, free of rubbish.
 - b. Backfill for all trenches, regardless of the type of pipe covered, shall be compacted to a minimum of 90% density.
 - c. Compact trenches in areas to be planted by thoroughly flooding the backfill. Jetting process may be used in those areas.
 - d. Dress off all areas to finish grades.
9. As-built Drawings and System Demonstration: Require that the sprinkler installer furnish fully revised and accurate as-built drawings of the piping, heads, and control wiring. The installer shall satisfactorily demonstrate coverage, operation, and sequencing of zones by scheduling a meeting with the Owner's Maintenance Department to review the as-built drawings and fully demonstrate the completed system. A second meeting shall then be scheduled as a follow-up to the first, for the purpose of answering questions and troubleshooting. In addition, the installer shall participate with Owner's Maintenance Staff to start-up and shut down the system in the course of the first season of operation. As-built shall be issued on both reproducible sheet medium (mylar) as well as AUTOCADD latest release.

VIII. SITE SIGNAGE

Aluminum traffic and pedestrian control signs shall be as shown on the drawings. Mount signs on perforated 2 1/2" square galvanized steel posts. Install posts in sleeves set in concrete.

~~VIII~~.IX. SITE IDENTIFICATION SIGN

A freestanding site identification sign, appropriate to the building design and budget, shall be included in the contract for new buildings. Photovoltaic power for front or remote signage is encouraged, preferred.

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X. TENNIS COURTS

The District recognizes that the sub-surface development for new tennis courts is critical for maintenance of a quality playing surface. The design shall include careful analysis and preparation of the sub-grade and, where possible, post-tensioned concrete courts are to be utilized. Coordinate positive site drainage away from courts in all directions.

XI. EXTERIOR BLEACHERS

Aluminum bleachers shall have a clear anodized finish with manufacturers standard aluminum non-slip seat and footboards. Guardrail system shall be included at rear and each side to meet IBC and ADA standards.

~~XII.~~ BICYCLE RACKS

AAA Ribbon Rack Model No. RB11 or approved substitute. Hot dipped galvanized finish in ground anchor mount.

~~XIII.~~ EXTERIOR BASKETBALL BACKSTOPS

Porter Model No. 00164-334, or approved substitute, with No. 00223-000 goal on painted aluminum fan bank.

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DIVISION 3 - CONCRETE

I. SPECIFICATIONS

Shall be based on applicable portions of ACI, CRSI, and ASTM standards, latest editions.

Specification description of methods and materials shall clearly outline all requirements of the work. ACI and ASTM Standards numbers should be used as reference only to expand or substantiate the basic information shown in the specification.

Shop drawings for reinforcement, mix designs, and pre-stressed units shall be required.

II. FORMWORK

- A. Specify design for lateral pressure and loads in accordance with ACI and wind loads as per applicable sections of the controlling local building code.
- B. Specify tolerances for formed surfaces.
- C. Specify applicable materials for concrete finish desired.
- D. List form and shoring removal times.
- E. Chamfer exterior corners of concrete surfaces.

III. REINFORCING

- A. List materials and give specific ACI and ASTM specification designations.
- B. Specify placement methods and reinforcement coverages.
- C. Specify anchor bolts.
- D. Specify and show rebar anchorage between foundation walls and exterior platform at exterior doors to limit frost heave.

IV. CONCRETE

- A. List all materials. Call for concrete in conformance with ASTM C-94, latest edition. Air entrainment is required for all exterior concrete. Calcium chloride admixtures are prohibited.
- B. Specified design mixes shall be submitted to and approved in writing by Architect prior to placement of any concrete. Send copy to Owner. The Contractor shall furnish evidence satisfactory to the Architect that all materials to be used and proportions selected will conclusively and uniformly produce concrete of the quality specified. Mix designations of approved mix design shall appear on all truck delivery tickets.
- C. Specify size of aggregate, minimum and maximum slump for each class of concrete, air content percentages, and minimum strength at 28 days.
- D. Specify placement procedures. List hot and cold weather requirements for placement of concrete, and protection and curing standards.

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- E. Specify and show type, size, and location of all control joints and expansion joints.
 - F. Specify floor surface finishes and the procedure for obtaining them. Typical floors shall be finished level to maximum tolerance of 1/4" in 10', except where drains occur, in which case they shall be sloped to drains.
 - G. Compatible sealers and curing compounds shall be specified for specific floor finishes (i.e. epoxy, VCT, carpet, etc.).
 - H. Concrete Testing - Testing agency shall be designated, secured, and services paid for by the Owner. Testing will be done per specified procedures. Architect will consult with Owner if additional testing is needed. Architect will consult with Owner regarding the number of tests, number of cylinders, etc. Averaging of separate tests to determine strength is not permitted. Contractor will contact testing agency to schedule specified testing.
 - I. Copies of the test reports will be forwarded from the testing agency to the Owner, Architect, and Contractor.
 - J. Concrete which fails to meet the specified strength requirements and which, in the Architect's opinion, cannot be brought into conformance, will be rejected and shall be removed and replaced at the Contractor's expense.
 - K. Acceptance criteria for formed surfaces shall be specified.
- V. COLORED CONCRETE
Use red-colored concrete at all handicap ramps. Colored concrete shall not be employed except as specifically approved by the Owner.

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DIVISION 4 - MASONRY

I. SAMPLES

- A. Architect shall require physical samples of each type of brick and block and sample panels of wall as designed.
- B. Specifications should require that all brick for the entire project shall be supplied from a single kiln run of brick.

II. STANDARDS AND TESTING

- A. Call out specific Brick Institute of America, Concrete Masonry Association of America, ANSI, ASTM, and other applicable standards.
- B. Require prism tests, if size of project warrants, which will be paid for by Owner.
- C. On additions, materials and colors shall match (compliment) existing masonry.

III. MORTAR AND GROUT

- A. List all mortar materials. Use ASTM designation numbers for each.
- B. Mortar Proportions - Specify in accordance with structural requirements for this project. Specify minimum strength required at 28 days. Design mix shall be submitted, with tests being made at the Owner's option and expense. Use of fly ash and calcium chloride admixtures are prohibited.
- C. On additions, observe mortar color before specifying, and require color matching, including possible use of white cement and coloring agent, if necessary.
- D. Grout Proportions - Specify in accordance with structural requirements for this project. Specify minimum strength required at 28 days. Design mix shall be submitted.

IV. BRICK AND BLOCK

A. Materials:

- 1. Brick - Brick from at least two manufacturers should be selected by the Architect and including in the specifications by name.
- 2. Masonry Block - specify color, texture, classification and compressive strength. Require bullnose block at all external corners in building interior and all special shapes required to complete the design detail.
- 3. All materials should match those used on approved sample panel, where sample panel is specified.
- 4. Seal exterior walls, especially concrete block and specify appropriate through wall flashing.
- 5. Use of split face or ground face CMU shall be reviewed and approved by the Owner.

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V. ACCESSORIES

- A. Call for specific engineered masonry ties at masonry veneer construction, to suit wall construction.
- B. Call for all miscellaneous accessories, including but not limited to reinforcing steel, horizontal reinforcing, flashing and insulating materials.
- C. Provide for cornerstone, time capsule, or other historic storage device or method.

VI. REINFORCING

- A. Specify placement of masonry reinforcing type, size, and spacing.
- B. Call for cleanouts for grout lifts of more than 4 feet. Cleanouts should not be visible after completion of wall.

VII. EXECUTION

- A. Specify mortar batching controls applicable to the job.
- B. Specify hot and cold weather requirements for masonry work.
- C. Tool all exposed joints. Concave round is preferred.
- D. Specify requirements for replacement or patching of damaged masonry units.
- E. Specify brick cleaning materials and methods approved by manufacturer of masonry units. If possible, specify that masonry cleaning be done within a short period of being laid, and not at end of construction.
- F. Masonry block units should be cleaned of all mortar spots, fins, and projections. Block wall surface should be smooth to the touch prior to painting.
- G. Apply sealant and anti-graffiti material to walls vulnerable to vandalism, as approved by Owner.
- H. Seal exposed interior faces of integral color or ground face masonry units.

VIII. CONSTRUCTION SHORING

- A. Construction shoring is required by Contractor. Wind danger is high in much of the School District.

<<<<END OF DIVISION 4>>>>

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DIVISION 5 - METALS

I. WELDING

All shop and field welding shall be done by welding operators qualified in accordance with the American Welding Society Standard Qualification Procedure. Current Certificates shall be provided to the Architect.

II. TESTING

Testing of welds will be completed by the testing agency as directed by the Owner or Architect, paid by the Owner.

III. STRUCTURAL METAL

A. Include a statement similar to the following:

The AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings, latest edition, and the AISC Code of Standard Practice for Steel Buildings and Bridges, latest edition, are hereby made a part of these specifications to the same extent as if they were written herein, except as they may be amended or superseded by these specifications or the drawings.

B. Splices of material not specifically shown on the drawings will not be permitted without written permission from the Architect and structural engineer.

C. Shop drawings will be required for this section of the Specifications.

D. Shop paint all members (except those embedded in concrete) with rust inhibitive paint. After erection, touch up connections and abrasions with same type of paint.

E. Specify baseplate-grouting requirements.

F. Contractor shall submit the qualifications of the erector to the Architect for his consideration and approval prior to the start of the erection.

IV. STEEL JOISTS

A. Follow recommendations of AISC/SJI Standard Specifications.

B. Shop drawings are required for this section.

C. Shop paint all joists with rust-inhibitive paint.

D. Specify specific bridging and lateral support requirements.

E. Remove fabrication tags from exposed ceiling/roof joists

V. METAL DECK

A. Erector qualifications: 5 years minimum experience on comparable roof deck projects.

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- B. Panel design in accordance with American Steel and Iron Institute's "Specification for the Design of Light Gauge Structural Steel Members," latest edition.
- C. Use acoustical deck at all interior exposed locations, as may be applicable.
- D. Use sump pans for all main roof drains.

VI. METAL FABRICATIONS

Fabrications shall include but not be limited to the following:

- A. Ladders or stairs to roof. Ladders between different roof levels. Stairs are preferred.
- B. Doorstops - Provide pipe rail doorstops at each exterior door where wall stops are not practical.
- C. Footscrapers - Provide one at each building entrance, as required.
- D. Handrails - Locations as required by code. Provide for sufficient anchorage for various conditions. Provide handrails at sides of stage or platform risers.
- E. Trench covers and gratings should meet ADA requirements.
- F. Roof Access Hatch - Minimum 3' x 3', with 14 gauge cover. Omit outside handle and hasp.
- G. Building Expansion Joints - Metal covers at floor, wall, and ceiling.
- H. Supports for stage lights, operable partitions, and all curtains.
- I. Plaque - Provide space and specify a bronze plaque 18" x 24" in the entry area. Location to be coordinated with the Owner.
- J. At all elementary schools provide foot scrapers when a door stop is specified (coordinate with Doors Section) as required at entrance doors to student areas or public use areas. Coordinate with Facilities for standard detail. Combine with door stop.

<<<<END OF DIVISION 5>>>>

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DIVISION 6 - CARPENTRY

I. ROUGH CARPENTRY

- A. Framing: Design and construction to conform to IBC and National Design Specification for Wood Construction, latest edition, as published by National Forest Products Association.
- B. Lumber: Standard. Conform to Grading Rules of Western Wood Products Association.
- C. Plywood: Conform to Grading Standards of American Plywood Association. Specify plywood for telephone backboard.
- D. Particleboard: Be specific as to exact type required, referring to ANSI 208.1. Avoid use of products containing urea-formaldehyde
- E. Incorporate appropriate standards for manufactured products such as glued laminated wood, prefabricated joists, etc.
- F. Specify all furring, backing and blocking with appropriate fire-retardant or moisture - preservative treatment, for equipment to be installed by others.
- G. Incorporate reinforcement and backing as required at all wood framing for stability (particular attention directed to framing of a half-wall partition).

II. FINISH CARPENTRY

- A. Specify materials and installation for all trim.
- B. Fabricate millwork cabinets, shelves, etc., of hardwood-surfaced plywood, plastic laminate finish or particleboard of sufficient density to prevent screw pullout at below 300 pounds. Avoid use of urea-formaldehyde products.
- C. Millwork and casework must be built to AWI standards and shall be specified to conform to "custom" grade.

<<<<END OF DIVISION 6>>>>

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DIVISION 7 – MOISTURE PROTECTION

I. DAMPPROOFING AND WATERPROOFING

- A. Specify dampproofing including flashing for exterior face of all walls that enclose interior area. This should include crawl spaces. Specify waterproofing at exterior walls enclosing occupied spaces below grade.
- B. Show extent clearly on drawings. If waterproofing and dampproofing are both to be used, clearly define all areas for each.
- C. Specify vapor barriers under slab floors, and around drilled piers.

II. INSULATION

- A. Insulation used in combination with other building materials shall give minimum "U" factors in accordance with the requirements of current ASHRAE Standards and IBC.
- B. Preferred minimum aged "R" values for insulated surfaces are:

Roofs:	R40
Exterior Walls:	R19
Foundation Walls:	R10

(Co-ordinate with mechanical design parameters.)
- C. When under occupied space, boiler room ceilings shall be sufficiently insulated.
- D. Foil faced insulation required at all plenum conditions.

III. ROOFING

- A. White roofs are preferred to enhance solar reflectivity. Roofing must be installed by a roofing contractor who has been in continuous business as a roofer in the State of Colorado for at least five years, who is located no more than 75 miles from the site, and who is licensed to install the specified roofing system.
- B. Roofing may be 4-ply built-up, modified bitumen, or single membrane elastomeric sheet. 4-ply built-up system is preferred on new construction. If single membrane, do not specify polyvinyl chloride (PVC). Minimum roof slope shall be no less than ¼" per foot in all directions. Slope valleys 3/8" per foot minimum between drains. Provide crickets at roof mounted equipment to maintain minimum slope. Consult Owner before designing sheet metal or concrete tile roofs.
- C. Submit roof plan showing slopes, details showing all roof perimeter conditions, roof curbs, etc. and all roofing specification sections, including insulation caulking and all sections pertinent to roofing, to the Owner for approval prior to finishing the Contract Documents.
- D. If two types of roofing are shown, it is essential that one roofer be responsible for the contract and warranty for both types of roof.
- E. Roofing system shall satisfy UL Class A and Factory Mutual Class I-90 requirements. Call for both 3-year installer's warranty, 10-year manufacturer's warranty on single membrane systems, and 20 year manufacturers warranty on built-up systems, unless longer term is available from

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manufacturer, in which case, consult with Owner before specifying. Provide five (5)-year extended warranty as a Bid Alternate.

- F. All roofing components, including flashing, fasteners, insulation, roof vents, ballast and expansion joints, shall be in strict compliance with manufacturer's written recommendations and details, except for more stringent modifications by Architect.
- G. Attempt to locate all roof drains in areas where they will not be shaded from the winter sun.
- H. Provide walkways in accordance with roofing manufacturer's recommendations for all roof areas likely to receive foot traffic to rooftop mechanical units, etc.
- I. Roofing on additions shall be chemically and physically compatible with existing roof.

IV. SEALANTS

- A. All exterior joints to receive caulking, specify sealants and their installation procedures. Materials must develop UL rated assemblies where required.
- B. Interior joints to be caulked - acrylic latex caulk or equal.
- C. Call for color samples and written information describing each type of caulking to be submitted to the Architect for approval prior to commencement of caulking work.

V. SHEET METAL AND FLASHING

- A. If referring to SMACNA standards or details, be specific as to which standards or details.
- B. 24 gauge minimum at exposed Kynar Resin prefinished wall cap/gravel stop. 22 gauge minimum at all other painted G.I. flashing.
- C. Butt and caulk end joints, using hemmed joint cover or backing member. Do not solder or attach with sheet metal screws, provide for necessary expansion control. Pre-formed corner joints. Not appropriate for pre-finished metal.
- D. Carefully detail top edge of all metal flashing to assure a secure, watertight connection.
- E. Provide sheet metal rain cap and flashing on all masonry parapet walls, except where stone or other monolithic material is used in conjunction with flashing. Where stone, precast, brick or block caps are used, install proper anchorage and through-wall flashing.
- F. Parapet tops shall be sloped to drain toward roof.
- G. All exposed sheet metal to result in neat straight lines, without waviness, bowing dents, or oil-canning.

VI. ROOF DRAINS

All roofs should discharge water below grade (if possible) away from foundation of building. All discharge above grade must be reviewed carefully to prevent ice build-up. Where roof drains discharge into site, set at base of bank, not at top. Protect downspouts and gutters from freezing, and discharge of water over sidewalks. Provide spillway at discharge of drains. Drywells shall not be used. At exterior downspouts and leaders, detail to discourage climbing or abuse. All roofs shall drain to the soil – no discharge across sidewalks, dripping off overhangs without gutter, etc.

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VII. SKYLIGHTS

Where used, provide 12" curbs and Lexan or polycarbonate glazing. Consider clerestory or monitor windows as preferred alternatives. Provide means of darkening classrooms. Follow Manufacturer's recommendations for materials used according to size.

VIII. CONSTRUCTION PROVISIONS

Specify that roofing contractor shall provide temporary waterproofing for all work during roofing construction.

<<<<END OF DIVISION 7>>>>

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DIVISION 8 - DOORS, WINDOWS AND GLASS

I. DOORS - WOOD

- A. All interior wood doors should be 1¾" pre-finished solid core, AWI custom grade, 5-ply, with wood particle or staved wood cores. The astragal shall be 2-1/4" thick. A lifetime of the building guarantee is required for all solid core wood doors. Do not use mineral core wood doors unless approved by Owner. Use hollow metal doors where above described doors do not meet code requirements.
- B. Where exterior entrance doors are recessed, recess depth shall be at least equal to the width of the door leaf. Use wall stops at each recessed door and coordinate width and depth of all door recesses with door hardware and stops. Aluminum exterior doors and frames will be considered, use only if approved by Owner. Where wall stops are not possible, provide 33" or 34" high posts for doorstops, set in concrete.
- C. Groups of paired doors should be designed so that two doors are not hung from a single mullion. If a single mullion is required, it must be reinforced.
- D. Doors should swing so as not to interfere with traffic flow. Louvered doors, where permitted by Code, may be used to improve ventilation in toilet rooms, offices, storage spaces, etc.
- E. Standard door height should be 7'-0" unless otherwise required.
- F. Doors to Music Rooms should be sound sealed and filled, and have a sound transmission rating approximately equal to that of adjacent wall construction. Special hardware may also be required at music rooms.
- G. Provide a window in all occupied spaces.
- H. Overhead sectional, security grilles, and all other special doors shall be reviewed with the Owner for approval.
- I. Architect should submit proposed detailed specifications for all folding doors. Provide adequate structural support for track to keep deflection within manufacturer's maximum allowable.
- J. Provide a screen door for the exterior entrance to the kitchen. Service door to kitchen should be 4'-0" wide.

II. WINDOWS

- A. Exterior windows should be aluminum-clad wood, such as Pella, thermal break aluminum, or hollow metal framed. Interior borrowed lights and vision panels should be constructed with hollow metal frames.
- B. Fixed-glass windows are preferred to operable windows. Operable windows prevent the effective and efficient operation of Air Conditioning and HVAC designs, and pose security concerns.
- C. Where permitted, vents should be top hinged, in swinging, and shall be weather-stripped. Vent windows should not project into traffic areas.

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- D. Provide vandal resistant screens on all vented windows.
- E. All windows shall be minimum 7/8" double-glazed with snap-on beads and vinyl gasketing.
- F. Follow requirements of ASHRAE 90-75 and IBC for thermal design of exterior walls. This will affect the number and size of windows used.

III. GLASS AND GLAZING

- A. Exterior Glazing. Specify type and thickness as required by location to meet code requirements. Use insulating glass. If high performance, follow manufacturers recommendation for heat treating and setting to avoid breakage from shade induced thermal stress.

Utilize "Low E" glass where applicable.

Film products need to be investigated further. Films provide a security barrier, shatter-proofing, retard solar gain, and serve as an insulator. Low-cost double pane glass with film may be more valuable than expensive integral film products with high maintenance/repair costs.

- B. Interior Glazing:

- 1. Use wire glass for fire rated openings.
- 2. Use tempered or laminated safety glass for all other interior glass except as noted.
- 3. Use double (acoustical) glazing in music areas.
- 4. Polycarbonate (Lexan or equal) at gym office interior window and as approved by Owner and Fire Department.
- 5. Thickness of material should be as recommended by manufacturer for size of opening. Uniform thickness throughout building is desirable, if possible.

- C. Code Requirements. All glass shall comply with all code requirements concerning the use of safety glazing materials in hazardous locations.

IV. VISION STRIPS

Except for toilet and utility room doors, all doors shall have vision strips. Vision strips to be of wire or tempered glass, a minimum of 6" above panic bar. Vision strips to be installed in upper half of door only.

V. PANIC DEVICES

Provide mullions at all pairs of doors requiring panic devices, key operated removable if necessary.

VI. GLASS BLOCK OR GLASS

Glass block or glass in walls above gym floors is discouraged. Glaze any areas above doors with non-breakable or shatterproof material, i.e., plastic, wire glass, safety glass, etc.

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- E. Specify conduit to the head of all exterior doors and integral sensors for door position sensors.
- F. The reinforcing plate should be a one-piece integral unit, bent for flush mounting of hinges. Cover boxes should be provided in back of all hardware cutouts. Provide flush removable access plates as required. Fabricator should correct any inaccurate preparation for hardware.
- G. Frame anchors should be as follows:
 - 1. Concrete or Masonry walls - Welded-on minimum 14 gauge adjustable strap anchors, specify size.
 - 2. Metal stud walls - Welded-on "Z" stud anchors.
 - 3. Wood stud walls - Double studs at both jambs, and screwed jamb anchor clips.
- G. One anchor for each 3' of frame height but not less than 3 anchors on each side should be provided. Minimum 12 gauge metal adjustable clip angles should be spot-welded to bottom of each jamb member; provide holes in angles to receive floor anchorage.
- H. Before shipment, install a temporary spreader at bottom of frames; do not remove spreader until frames are secured in place.
- I. After fabrication, frames shall be cleaned and given a shop coat of red oxide primer, baked on or bonderized and given a coat of gray zinc chromate rust inhibitive flow-coat primer baked on. Coordinate color of primer with final coating.
- J. For door openings wider than 42" and for multiple openings, head members should be reinforced full-length.
- K. Provide at least 2" jamb depth for doors with articulating hinges. Coordinate with Design Team.

IX. EXECUTION

- A. Doors and frames should be erected plumb and true, with all hardware left in proper working order. Erection shall be done by a professional door erector and in accordance with door manufacturer's instructions. Doorframes should be secured to floor slab with a countersunk expansion device or other approved method at each jamb. Build in wall anchors as specified.

X. FINISH HARDWARE

The following special requirements should be taken into consideration in preparing the Finish Hardware Schedule. ADA requirements shall be observed in all respects.

A. Building Security:

- 1. Certain parts of the building should be secured from use by unauthorized persons. Mechanical and electrical equipment rooms, office and storage rooms, kitchen areas, attic and crawl spaces, and roofs are to be locked against access by students. Stairs and corridors serving such spaces should also be similarly secured.

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2. Coordinate building security systems with Owner. Card access systems may be required on designated doorways, as specified by Owner. Cylinder dogging features should be installed at non-card reader controlled front doorway and other owner-designated exterior exiting devices.
 3. Some areas of the building will be made available for community use during non-school hours. In order to confine traffic only to designated areas it might be necessary to provide locking corridor doorways (preferred) or folding metal gates (discouraged) at certain points or corridors. Where gates are utilized, gate locks shall have cylinders matching balance of building system. Since gates cannot be used at stairways to restrict access to upper floors, locking exit devices will be required at certain stair doors. The locations of both the corridor gates and exit devices must be carefully studied to meet the requirements of each building and the IBC.
 4. Automatic doors are required at front entry per Owner and ADA requirements.
- B. Removable Mullions. Keyed removable mullions should be specified at the following locations:
1. One pair of exterior entrance doors. Coordinate all locations with Facilities Department.
 2. One pair of doors from corridor to auditorium near (or on) platform or stage, and any pairs of exterior doors at stage, gymnasium, media center, or multi-purpose room.
 3. Standardize keys for mullions with Owner.
 4. Avoid use of mullions in abusive or high traffic areas.
- C. Door stops and Holders:
1. All doors should be allowed to swing as far as trim or closer will permit.
 2. Stop locations in order of preference are as follows:
 - a. Wall
 - b. Overhead
 - c. Closer hold-open/stop on kitchens and delivery doors
 - d. Bollard stop at exteriors
 3. Exitways should be planned so that floor stops are not located in areas where they will obstruct traffic.
 4. Locate exterior doorstops as far as possible from hinge side to minimize possibility of vandalism as far as possible from hinge side.
 5. Provide jamb reveals at recessed doors to allow doors to open wider than 90°. Provide a stop to prevent surface-mounted closers from striking walls or other obstructions.
 6. Overhead door holders are to be used as required.
 7. Consider use of stops at doors with exit devices without knob or pull.

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8. Consider using magnetic hold open devices at office, gymnasium, and secured corridors if codes and budget permits.

D. Closers:

1. Surface closers should be used on all doors where closers are scheduled.
2. Parallel arm mounting shall be used in every possible application.
3. Use EDA arm only.
4. Closers are not to be mounted where exposed to the weather.
5. All closers should be non-hold open type except as specifically noted in scheduling guide.
6. School District standard is LCN 4111-EDA-TB.
7. Automatic Operators: LCN 4840 Series on front entries.

E. Panic Devices:

School District standard is Von Duprin 99L X994L. (With Von Duprin KR4954-MT54 removable mullions where applicable. Avoid the use of vertical rod devices at any location.)

F. Locks:

1. School District standard is Schlage C Key Way for interior doors, Schlage Primus on exterior , with lever handle. Coordinate lever design with Owner.
2. Provide Bid Alternate to lock classroom doors from the inside to prevent unwanted intruders from entering doorway.
3. Coordinate with Owner for doorways to be controlled by electronic access. Adopt Owner specifications for hardware and materials.

G. Continuous Hinges:

1. Applications include openings subject to high traffic or abusive areas. Exterior entry doors, vestibule doors, doors greater than 36" in width, and interior gymnasium doors at high schools and middle schools shall be included.
2. Provide Owner with cost/benefit analysis of pin-in-barrel versus geared type hinges.
3. Use stainless steel hinges.

H. Weather-stripping:

All exterior doors shall have continuous commercial-grade bulbous-type weather-stripping.

I. Threshold:

All exterior doors shall have weather-resistant thresholds.

J. Protective Plates:

Incorporate protective kick plates on push side of doors in all high traffic doorways including kitchens, restrooms, gymnasiums, cafeterias, media centers, mechanical/electrical rooms, and custodial areas.

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- K. Flush Bolts:
Use flush bolts on active leaf of pairs of storage rooms and other secure areas.
- L. Coordinators:
Specify coordinators as required by code.
- M. Extended Warranty:
 - 1. Provide for 6-month door hardware adjustment.
 - 2. Consult with Owner regarding extended warranty periods for finish hardware.

XI. BUILDING ADDITIONS

- A. Hardware for additions to existing buildings shall be coordinated with the existing keying system and be similar in design and finish to the original hardware with the following exceptions:
 - 1. Use cylinder locks
 - 2. Use lever-handle locksets on all new doors
- B. If an addition to an existing building is sufficiently large or if the old hardware is obsolete or inadequate it may be feasible to provide for the replacement of existing locks or cylinders with new hardware. Verify with Facilities Department.
- C. Drawer extension glides, sliding door hangers, track, shelves, guides, stops, shelf standards and support brackets should be furnished and installed with the millwork.

XII. HARDWARE SCHEDULE

The Contractor shall supply a complete detailed hardware schedule within 60 days after Notice of Award. The Architect shall consult with a certified architectural hardware consultant in the preparation of this schedule. This schedule shall include the following information:

- A. Name and description of each opening.
- B. Complete description of hardware provided, including manufacturer's name, catalog number, and quantities.
- C. Complete keying information.
- D. Any other information pertinent to proper installation.
- E. The General Contractor shall be responsible for the correct application of all hardware.
- F. The Hardware Consultant should be present to assist and/or instruct those applying finish hardware as required.
- G. Prior to final inspection the General Contractor shall check and adjust all hardware, including closer operation and keying. The Hardware Consultant should submit a certificate stating that closers and locks are installed in accordance with manufacturer's specifications. Certificate shall be required in Architect's Specifications.

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- H. Hardware required with window screens, steel windows, metal lockers, metal toilet compartments, metal-clad fire doors, rolling grilles, steel plate access doors, hatches and roof scuttles is to be furnished with these items.

XIII. MARKING OF HARDWARE

- A. Each package of hardware should be carefully marked for its intended opening and use and should be delivered to the General Contractor.

XIV. SCREWS AND BOLTS

- A. All necessary screws and bolts for proper installation shall be furnished by the hardware supplier. All shall be of suitable size, type and finish to harmonize with the hardware.

XV. METAL DOOR HARDWARE

- A. Hardware attached to metal shall be templated and shall be fastened with machine screws long enough to penetrate 1/4" thick reinforcing.
- B. Hardware templates for hollow metal doors and frames shall be delivered to the General Contractor immediately on receipt of the approval schedule of finish hardware.
- C. Hardware for hollow metal doors shall be delivered to the General Contractor.
- D. Rubber silencers shall be provided for all doors (except exterior and at smoke seals) installed in metal frames. There should be three silencers for each door.

XVI. MOUNTING

- A. Hardware mounted on wood doors and transom panels, such as panic devices, SB comment: and holding devices shall be attached to the door with sex bolts. Through-bolts and grommet nuts shall be used for attachment of closers to wood doors. The same classes of hardware mounted on metal doors shall be attached with machine screws.
- B. Attachment of hardware to brick or concrete shall be accomplished with expansion bolts or similar drilled anchors. Toggle bolts shall be used for attachment to masonry block walls. Solid backing shall be provided for hardware mounted to gypsum board walls. Wall mounted door stops shall be backed by wood blocking securely fastened between studs.
- C. Recommended mounting heights: Dimensions given are from floor to center line of hardware item.
1. Door levers: SB comment:
- a. Standard: 36"
- b. Kindergarten: 36"
2. Push Plates:
- a. Standard: 46"
- b. Kindergarten: 39"
3. Pull Plates:
- a. Standard: 39"

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- b. Kindergarten: 34":
- 4. Exit device cross bar:
 - a. Standard: 36"
 - c. Kindergarten: 34"

XVII. LABELED OPENINGS

Where code indicates A or B label doors, the labeling should control the hardware. Astragals and coordinators, where required on pairs of doors to meet labeling requirements, should be provided.

XVIII. SMOKE SEALS

- A. Where smoke seals are required, specify bulb-type silicone, such as Pemko S88 series.
- B. General Contractor shall comply with all current codes for smoke seals at rated openings. Integral seals with door/frame (rather than field applied seals) shall be considered. If this is not practical, specify bulb-type silicone (Pemko S88 series).

XIX. FINISHES

Required for all hardware:

- A. U.S. 26D.
- B. At additions, match existing finish (with approval of Facilities Department).

XX. KEYING

In general, locks should be Schlage, master-keyed to School District GGM, except on additions to existing buildings, which may be different.

- A. Key requirements should be coordinated with Facilities Department. Requirements will be determined on an individual project basis, in consultation with the District locksmith. All locks shall be factory keyed or installed by a district approved keying service.
- B. Two keys are to be provided for each lock bitting list.
- C. Temporary or construction keying system must be coordinated with the permanent installation and approved by the District.
- D. Provide steel key cabinet, mounted in administrative area. Organize all building keys in key cabinet according to printed keying schedule, before turning over to Owner's representative.
- E. IC Core shall be installed on all keyed doors with panic devices on door.

XXI. CYLINDERS

- A. All new cylinders furnished under this contract shall be of the same manufacturer's type and shall have the same keyway unless otherwise specified.
- B. Where more than one door occurs at an exterior entrance, provide a cylinder at only one of the doors. (This applies to Main entrances only.)

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DIVISION 9 - FINISHES

I. GENERAL

Finishes and items listed below shall be minimum acceptable for area indicated.

- A. Kitchen walls and ceilings must be constructed of materials that will not suffer damage as a result of repeated washing. Walls finished with glazed tile, epoxy paint, or other approved non-porous finish. Ceilings finished with epoxy paint, vinyl faced panels, or other approved non-porous finish.
- B. Kitchen and toilet room floors shall be seamless material, epoxy resin, or other approved non-porous material with wainscot.
- C. Vitreous type glazes should not be used on exterior walls or walls exposed to moisture, glazed structural tile are recommended.
- D. At Gymnasiums, walls to door height should be of materials resistant to hard use. Finish should be non-abrasive, resistant to marking and scarring, and of material that can easily be cleaned.
- E. Gym floors in Elementary Schools - consider carpet sports floor covering as well as third grade maple. Rubber and acrylic-based floors are also acceptable.
- F. Gym floors in Secondary Schools - synthetic materials or second (or third) grade maple parallel with long dimension of gym. Do not use Parquet type of floors. Allowance is to be made for expansion of the floors. There shall be adequate protection from moisture gain from floor base. The layout for the gym floor markings will be laid out by the Architect on consultation with the Owner. Lines are to be painted prior to the final coat of floor finish. Floor finish shall be low VOC, Eco-Lab gym finish, or other approved finish system.
- G. Floors around shop machinery should be non-skid, abrasive, oil resistant type.
- H. Ramps and locker room floors should have non-slip surface.
- I. Provide appropriate matching base at all flooring. If resilient type, adequate backing should be provided, base should be provided, and base should be securely adhered to backing.
- J. Resilient tile flooring shall be provided in art and science rooms, and near sinks in classrooms, cafeteria, and applied technology labs.
- K. Consider use of maintenance-free alternatives such as quartz.

II. LATH AND PLASTER

- A. Materials, application, and workmanship shall be in accordance with the latest edition of American National Standards Institute specifications (ANSI), for gypsum plaster and portland cement stucco.

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III. GYPSUM DRYWALL

- A. Work and materials shall conform to the latest edition of ASA (ANSI) Standard Specifications for the Application and Finishing of Drywall and Standard Specifications for the Installation of Steel Framing members to receive screw attached gypsum wall board and backing board.
- B. Install water-resistant gypsum board adjacent to, behind all plumbing fixtures, and in any other moisture prone areas full height of wall.
- C. Gypsum drywall supports at 16" o.c. maximum spacing.
- D. Utilize reinforced impact resistant gypsum board at corridors.
- E. Finish gypsum board joints and fasten dimples to a "class 4" finish typical, with class 5 as noted – i.e.: skylights..
- F. Cement board shall be utilized as substrate for tile installations on framed walls.

IV. ACOUSTICAL TREATMENT

- A. Suspended acoustical ceilings should be 2 x 4 lay-in non-asbestos-bearing panel type with fissured face tile. 2 x 2 tile acceptable in special cases. Adhesive applied tile is not recommended.
- B. A complete reflected ceiling plan at all areas to receive this type of ceiling should be provided, showing integration of light fixtures, diffusers and ceiling-hung equipment.
- C. Samples of all materials to be used should be provided to the Architect for review and approval.
- D. Special purpose acoustical treatment in auditorium, music rooms, and gymnasium should be in accordance with current acoustical design practices. Architect should submit recommendations to the Facilities Department for review.
- E. Clearly define support system for all acoustical tile ceilings. This requirement is particularly important for remodeling work.
- F. If ceiling is desired in gymnasium or locker rooms, specify impact resistant components such as Tectum "Acousti-Tough," Armstrong "Armatuff" with impact clips, or equal. Standard hold-down clips are not acceptable. Specify tile with abrasion-resistant surface.
- G. Suspend acoustical ceiling panels in moisture prone areas or areas requiring frequent cleaning shall be vinyl faced.
- H. Sound insulation should be provided around office areas, toilet rooms, and mechanical equipment rooms. Submit recommendations to the Facilities Department.

V. RESILIENT FLOORING

- A. Resilient flooring should be 12 x 12 vinyl-composition tile, 1/8" thickness.
- B. Base should be 4" coved rubber base. 6" base on restroom walls with a 4" starter course. Carpeted areas should also receive topset coved base. Premolded outside corners should be

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specified. Consider continuous installation, bent around corners (scored on back). Premolded corners tend to kick free and are replaced with non-matching colors.

- C. Non-slip VCT or rubber tile (as approved by Owner) shall be utilized at ramps and landings.
- D. For sheet vinyl, a welded vertical seam is required.

VI. CARPETING

- A. Carpet shall be resilient or rubber-backed, as recommended by the Facilities Department and must be designed to resist pulling and unraveling. No jute back material will be accepted. Owner preference is for Collins & Aikman Sail Away or Bigelow/Mowhawk.
- B. Edge strips - vinyl or rubber only.
- C. Carpet installation should comply with standards established by American Carpet Institute and should be by a carpet shop with at least four years experience in this type of application.
- D. Drawings, showing the floor layout of all carpet areas and indicating all seams and edge strips should be required.
- E. Avoid use of carpeted stairs.

VII. SEAMLESS FLOORING

- A. Omnituff, Quartzite 6000, or approved equal, epoxy resin, quartz granules, acrylic flakes. Apply to minimum thickness of 1/8".
- B. Actual samples shall be provided to determine level of slip resistance.
- C. Installation should be by a Contractor approved by the material manufacturer. Contractor shall furnish a list of ten local installations using this material for review prior to installation.
- D. Installation shall include integral coved base.
- E. Investigate manufacturer's requirements for vapor barriers below slabs on grade, and specify appropriate barrier in these areas.

VIII. PAINTING AND FINISHING

- A. General:
 - 1. Use only district-approved paints palette, including pre-approved colors and finishes.
 - 2. Stain only on exterior wood is unsatisfactory; provide a minimum of two coats of finish on recommended base coat.
 - 3. Concrete block should have one coat of filler-sealer and a minimum of two coats of paint. At areas where epoxy paint is to be applied (toilets, kitchen areas), block filler is to be applied with squeegee to insure that all pores are filled before application of epoxy.
 - 4. Drywall, concrete, or plaster should have one coat of suitable primer and a minimum of two coats of semi-gloss enamel.

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5. Cooler and freezer if built-in should have one coat of primer and two coats of high gloss epoxy paint.
6. Metal work which is factory primed, should have minimum two coats of finish.
7. Exterior steel rails, hollow metal doors and frames shall be finished with a high performance coating (Themec or approved substitute).

B. Specifications:

1. Provide detailed specification based on the complete line of one manufacture, with a list of approved equals.
2. Call out work to be painted or finished, and work not to be painted or finished. Include surface-mounted electrical conduits, boxes and wiremold in materials to be finished, when they occur in finished areas. Also include exposed metal objects on roof (mechanical units, intake hoods, ladders, etc.). Emphasize in pre-installation meetings.
3. Submit appropriate product data to define each specified finish system along with stain and color samples required for selection and approval.
4. Specify job conditions, storage, surface inspection prior to painting, surface preparation, material mixing, temperature and humidity conditions of work, cleanup and protection.
5. Specify "professional best grade" products with primers and undercoat paint produced by the same manufacturer as the finish coats.
6. Provide detailed requirements for application, including application methods, mil thickness and surface texture.

IX. EXTRA MATERIAL

The following items should be provided to the Owner at completion of building, identified where used. Leave all items at building as directed.

- A. One unopened gallon of paint for each color and finish used.
- B. One case of resilient floor tile for each color used plus one-half case each of edging, topset base or inlay tile strips.
- C. One roll of each color or texture of wall fabric.
- D. One case of each type and size of acoustical tile.
- E. Ample supply of ceramic, quarry, and miscellaneous tile as required.
- F. Carpet: Furnish Owner with all usable scrap plus 2% overrun of each color and type used. Usable scrap is defined as any scrap piece over 2 sq. ft. in area and wider than 8".
- G. Adhesive: Furnish Owner with one (1) extra gallon of each type of flooring adhesive used.

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DIVISION 10 - SPECIALTIES

I. GENERAL

Items listed hereinafter are items that are required generally; additional items as may be required for specific projects will be listed in Specific Programs.

- A. Provide tapered aluminum flagpole with 30-foot exposed length on all new school projects (Fiberglass poles not acceptable.)
- B. Provide bronze interior dedication plaque at new buildings. (Consult with Owner on text and material.) Provide building name mounted on exterior of building or site sign for all new buildings. At larger buildings consider building directory at main entrance.
- C. Provide recessed locked cabinets with break glass front for fire extinguishers. Contractor will furnish minimum 10# ABC dry chemical multi-purpose extinguishers.
- D. In gymnasium, provide inserts, clamps, mat straps, etc., for ropes, nets, etc. School District will furnish all equipment. Inserts will be supplied by Owner and set by Contractor. Verify location with Facilities Department.
- E. Wall mounted folding gates with recessed cabinet and door for security during night usage are preferred, but do not violate IBC exiting requirements as to dead-end corridors, etc. (Overhead coiling doors will be considered where required, use only where approved by Owner.)
- F. Do not use rolling or folding wood slat type dividing partitions.
- G. Provide 2-foot square grid on ceiling of facility for performance to support cyclorama and lighting. Grid to be inserts or channel units similar to Unistrut.
- H. Coat hooks should be of metal construction and installed in such a manner as not to constitute a hazard to students. Allow sufficient space between hooks for bulky garments. In elementary schools, provide raised boot shelf below coat hooks. Wood dowels are not acceptable!
- I. At display cases, either specify concealed lighting, or detail case to make light source indirect as directed by Owner.

II. MARKERBOARDS, AND TACKBOARDS

A. General.

Show marker board, and tackboard size, location and construction details on the drawings. Marker and tackboards with aluminum trim should be as manufactured by Alliance, Greensteel, Claridge, or approved equal. Samples of each showing details of construction, color finish, and aluminum trim should be submitted to the Architect for approval.

On completion of the work furnish a certificate from the manufacturer stating that all porcelain enamel steel chalkboards and markerboards are guaranteed for the life of the building.

B. Materials - Chalkboard and Marker board.

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1. Marker board surface should be a 24 gauge minimum gauge fused surface, porcelain enamel steel facing sheet factory laminated to a 1/2" fiberboard core with aluminum backing sheet. Color shall be as selected by the Owner from the manufacturer's standard colors.
2. Music room marker boards shall include manufacturer-installed permanent scored lines and cleft.
3. Writing surface should be at least equal to the latest edition of Performance Specifications for Porcelain Enamel Chalkboards of the Porcelain Enamel Institute.
4. Markerboards should be furnished in single sheets up to 12 feet long. Where longer boards are required they should be jointed using butt joints with adequate backing to provide a firm surface on each side of the vertical joint.
5. Chalkboards are only acceptable in art room applications.

C. Materials - Tackboards.

1. Tackboards should consist of 1/8" thick textured vinyl-faced sheet cork or plain cork factory-bonded to 3/8" fiberboard. Color of all tackboards shall be as selected by the Architect from the manufacturer's standard colors.

D. Aluminum Trim.

1. All aluminum trim should be the screw-on type, with oval-head countersunk screws, and should have an anodized satin finish. Care should be exercised to avoid sharp or dangerous corners.
2. Specify trim numbers for the following: Edge molding, Intermediate molding, map rail, map hooks (one per 2 ft. of map rail), chalk rail (with 1" min. radius at exposed ends).
3. Markerboards in gymnasiums and high activity areas should have the rail mounted at the top of the board or recessed.

E. Execution.

1. All units should be installed in accordance with manufacturer's printed instructions. Consider using moly bolts for gypsum board and expansion shields for masonry. Provide all blocking required for proper anchorage.
2. All markerboards and tackboards shall be backed and shimmed to prevent any "bounce," and to be completely rigid.

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III. TOILET ROOM PARTITIONS

- A. Toilet Partitions. Shop drawings should be required for this section and should include brochures including full specifications, and color chips of all standard colors.
- B. Materials. In all high and middle schools, combat partitions are preferred. Consider concrete block with hollow metal frames.
1. Type – Preferred toilet partitions should be molded flush type overhead braced, Approved Manufacturers are: Accurata, General Partitions Manufacturing Corp., Robart, Ferrometal, Weis, Sanymetal or approved equal. If metal, finish shall be baked acrylic enamel.
 2. Dividing partitions should be 1" nominal thickness with sound deadening core and 20 gauge galvanized, bonderized steel facing sheets. Edges of sheets should be securely jointed and welded at 18" maximum spacing.
 3. Pilasters should be 1 1/4" thick with sound deadening core and 20-gauge galvanized, bonderized facing sheets. Pilasters extend from floor to top rail and should be securely anchored at top and bottom. (Consider the use of floor to ceiling or ceiling-suspended pilasters at high schools and middle schools.)
 4. Doors should be the same construction and finish as dividing partitions.
 5. Hardware should include adjustable gravity hinges, concealed latch, strike and keeper, coat hook and bumper, floor shoes, and stirrup brackets. Use theft-proof screws for attaching hardware. Finish should be chrome plated or stainless steel.
- C. Shower Stalls.
1. Use 1" thick solid high density polyethylene plastic partitions and pilasters in shower rooms, and consider using similar partition for toilet stalls in close conjunction with shower areas.
- D. Execution.
1. Toilet partitions should be rigidly installed plumb and level, complete with all fastening devices in strict compliance with manufacturers printed instruction.

IV. TOILET ROOM ACCESSORIES

Coordinate all specified items with Owner/Vendor supplied items supplied for installation by the Contractor.

- A. Hand Dryers: Specify an adequate number of electronic hand dryers in each student toilet room. Avoid paper towels in these locations.
- B. Paper Towel Holders: Owner furnished where required, installed by Contractor.
1. One at each single lavatory or pairs of lavatories in Staff toilets, and where there are no electric hand dryers.
 2. One at each classroom sink.

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3. Soap Dispensers and Toilet Paper Holders: Owner furnished, installed by Contractor.
4. Tampon and Sanitary Napkin Vendor: Twenty-five cent operated recessed stainless steel combination vendor, Bobrick B-3500 series. Install one vendor in each women's toilet room and in each girls' toilet room in senior high schools. Consult Owner concerning use in middle schools. Provide Sanitary Napkin Disposals, Bobrick B-270 or B-353 or approved equal adjacent to each water closet in women's rooms, and in girls' toilet rooms in middle and senior high school where tampon/napkin vendors are shown.

~~I.C.~~ Mirrors and Shelves: Mirrors should be No. 1 quality 1/4" polished plate glass with electro-copper back. Back sheet should be 23 gauge galvanized steel and shall have theft-proof mounting devices. Edge trim should be 1/2" wide 18 gauge stainless steel. Architect should size and locate all mirrors. At and handicapped mirrors, use taller or lower mirrors, or separate wall mirrors instead of tilt mirrors.

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~~I.C.~~ Provide one 48"-long book shelf in each boys and girls toilet room, preferably with hooks below.

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~~K.D.~~ Free-standing waste receptacles will be supplied by the Owner.

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~~L.E.~~ Execution: Install accessories in locations as shown on the drawings. Suggested mounting of all accessories is as follows:

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1. Masonry - Toggle bolts
2. Drywall - Wood screws into wood blocking attached between studs
3. Concrete - Expansion anchors

~~M.F.~~ Provide grab bars and other related accessories and hardware required for ADA compliance.

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V. LOCKERS

Check with district on locker standards, manufacturers.

Furnish and install metal lockers in the sizes required to satisfy requirements of specific programs.

A. Materials and Construction: At the time this Technical Guide is issued, the acceptable manufacturers, style, construction, accessories, and locking mechanism are under investigation and discussion within the School District. Coordinate with the Owner for specific direction in this regard.

B. Student Corridor Lockers:

1. Quiet lockers preferred. Provide sloped top at wall-mounted locations.
2. Construct doors and frames of pickled, cold-rolled and patent leveled sheet steel.
3. Construct doors of 16-gauge cold-rolled sheet steel adequately flanged. Weld all flanges together at corners. Construct frames of not less than 16-gauge steel formed into face channel shapes.

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4. Provide positive automatic type latching device. Provide three (3) latching points on single tier and two (2) latching points on multi-tier lockers.
5. Provide recessed handles and built-in combination locks.
6. Locker finishes shall be baked-on heavy coat of high quality enamel.
7. Provide pre-finished 16-gauge end finishing panel, where exposed.

C. Physical Education and Athletic Lockers:

1. Provide sloped top at wall-mounted locations.
2. Construct doors and frames of pickled, cold-rolled and patent leveled sheet steel.
3. Construct doors of diamond-perforated 14-gauge single piece cold-rolled sheet steel. Weld all flanges together at corners.
4. Construct frames of not less than 14-gauge steel formed into face channel shapes.
5. Provide positive automatic type latching device. Provide three (3) latching points on single tier and two (2) latching points on multi-tier lockers.
6. Provide recessed handles and built-in combination locks.
7. Locker finishes shall be baked-on heavy coat of high quality enamel.
8. Provide pre-finished 14-gauge end finishing panel, where exposed.

9. Execution.

1. Lockers should be installed by factory trained skilled mechanics with previous experience in locker installation work.
2. Lockers should be securely fastened to wall and to each other at top and bottom in accordance with manufacturer's recommendations. Furnish and install any additional anchoring devices as may be necessary to complete the installation in a satisfactory manner.
3. Furnish all necessary trim pieces, filler panels, and end panels as may be required to provide a complete installation. Trim pieces should be attached by means of bolts rather than clips.

VI. SIGNAGE

Provide room signs at each room, with room names at toilets and locker rooms, and Room Numbers at other rooms. Provide slide-in strips for room names and teachers' names (verify). Make size, location, and relief of signs to conform with ADA requirements, including Braille characters. Signage schedule and plan location shall indicate specific size, location, and number of each sign.

VII. FOLDING PANEL PARTITIONS

At classroom separations folding panel partitions shall be by Approved manufacturers with minimum STC rating of 43 (stage partitions rated 53) and gypsum board face panels finished with vinyl wall

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covering (matching adjacent VWC surfaces where applicable). Operation shall be paired hinged panels with hinged panel closure. Acceptable manufacturers and models:

- A. Hufcor Model 5500 or approved Substitution
- B. Factory must certify proper installation and operation as completed by Contractor.

VIII. ROLLING SECURITY GATES

The Owner prefers to eliminate or minimize the use of rolling gates.

IX. CORNER GUARDS

Heavy gauge solid color embossed PVC corner guards shall be applied to all outside corners of gypsum board partitions in corridors and high traffic areas. 2 1/2" x 2 1/2", floor to ceiling.

X. ROOM NUMBERING

Room numbering schemes should be coordinated to compliment the existing building systems. Coordinate with Auxiliary Services Director for logical numbering patterns to be used. Room number strategies should be determined at the design phase of the project and permanent numbers shall be used on drawings.

<<<<END OF DIVISION 10>>>>

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DIVISION 11 - EQUIPMENT

I. FOOD SERVICE EQUIPMENT

All equipment, both Owner and Contractor furnished, should be scheduled on the drawings. This schedule, keyed to a ¼" scale kitchen layout plan should include all equipment listed by item, description (manufacturer and number), indications of who furnishes and who installs each item and the connections required by mechanical and electrical. Note that the requirements listed below are general only, and that specific equipment and layout will depend on specific program. Any deviation from the guidelines must be listed as specified design phase submittal.

II. GENERAL DESIGN GUIDELINES

- A. Consider multiple use of cafeteria when not used for lunch periods. Consider use of furnishings that can have double use.
- B. Provide faculty-eating space for middle and senior high schools at approximate rate of 50% of faculty and administration staff at 12 square foot per person.
- C. Provide ala carte or snack bar space in middle and senior high school as a separate space from main dining and serving space but adjacent to total area.
- D. Consider storage space for PTA coffee, cups, etc. In schools that have modular scheduling, consider use of vending machines in central location which are able to be controlled to allow usage only at specified times.
- E. Provide serving lines and kitchens consistent with school enrollment, and in accordance with plans jointly developed by Owner's food service staff and Architect. In general, an overall square shape for kitchen area is efficient.
- F. Provide for kitchen or food services in cafeterias, commons areas, and conference areas for concessions and special events. Beverage dispensers, drains, outlets for appliances and other food activities outside of the kitchen should be considered.
- G. In all kitchens, provide the following:
 - 1. Walk-in refrigerator, walk-in freezer, and dry storage space accessible from receiving area. Most efficient dry storage space will have 18" deep storage shelves and 48" wide aisles.
 - 2. Locker area with lockers for kitchen staff, staff restroom, and handsink in kitchen area.
 - 3. Provide one tilt-skillet and one double convection oven with one serving line.
 - 4. Provide one tilt-skillet and one double convection oven with two serving lines.
 - 5. Provide one tilt-skillet and two double convection ovens with four or six serving lines.
 - 6. Provide ovens without legs; set with 1/2" overhang over raised platform, or on lockable wheels. Provide minimum 12" space behind range and ovens.
 - 7. Provide minimum of 6 feet for dirty dish table and 8 feet for clean dish table.

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8. Exterior door min. 3'- 4" wide, preferably 4'- 0", with in-swinging screen door.

H. Consider sound retardant factors for walls and openings between kitchen and adjoining spaces.

III. EQUIPMENT TO BE FURNISHED

Equipment needed in kitchen is dependent upon number served, specific design of kitchen, type of meals served. Provider (Contractor or Owner) is dependent upon individual project.

A. The following equipment is generally provided by the Contractor:

- 1 Ice machine (secondary only)
- 1 Walk-in freezer
- 1 French Fryer -- Fry Master. In secondary kitchens only. 2-compartment with filter and drain accessories included)
- 1 Walk-in refrigerator
- 1 Tilt-skillet -- Electric Cleveland 30 gal. Model SEL30T4
- 1 Combi-oven
- 1 Convection oven for secondary only
- 1 Cook's table
- 1 Bakers table with three rolling bins
- 1 Salad table w/ 3 drawers
- 1 Pot and Pan Rack, 18" x 48" -- overhead
- 2 Hot tables (with 4 wells each)
- 3 Cold tables (at secondary level)
- 1 VCM Vertical Cutter.Mixer, 30 quart Berkel Model VCM 44A1
- 1 Two-compartment vegetable prep sinks with disposer with time delay switch
- 1 Three-compartment sink
- 1 Dishwasher, single tank (elementary); Hobart 14AMT
- 1 Dishwasher hood
- 1 Dirty dish table with pre-rinse and disposer
- 1 Clean dish table w/ shelves beneath
- 2 Hand sinks
- Lockers, full height
- 1 Fire Suppression System
- 1 Range hood
- 2 Hot Box -- Food warmer/proofer

B. The following equipment is generally provided by the Owner:

- 1 Reach-in freezer, 60" wide by 87-1/4" high, 33" deep
- 1 Slicer 120 volts
- 1 Milk cooler
- 2 Bun racks
- 1 Cashier stand and chair

IV. EQUIPMENT REQUIREMENTS

Space and equipment requirements for on-site school kitchens are outlined in "Equipment Guide for On-Site School Kitchens" Program Aid No. 1091 U.S. Dept. of Agriculture.

Equipment specifications listed below, are subject to change depending on type of food service planned.

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- A. Cook's Table - 8' long by 30" wide and 34" high with 14 gauge stainless steel top and drawer fronts; three drawers, 20 gauge die-stamped galvanized steel. Provide two tables in schools over 1,000 pupils.
- B. Baker's Table - 8' x 36" x 34" high with 1-3/4" thick maple top; body of table of 18 gauge galvanized steel; three independent rolling bins with sliding tops of 18 gauge galvanized steel of 200# capacity each, on ball bearing swivel casters with rubber tread; three 20" x 20" x 5", 20 gauge die-stamped galvanized steel drawers with nylon rollers. Provide two tables in schools over 1,000 students.
- C. Salad Table - 8' x 30" x 34" high with 14 gauge stainless steel top, two 20" x 20" x 5", 20 gauge die-stamped drawers with nylon rollers, one shelf 6" above floor. Balance of table 18 gauge galvanized steel.
- D. Convection Oven - Blodgett-Zephaire Model FA-100, gas fired, rack type, 85,000 BTU with stainless steel doors and black finish. Equal units by other manufacturers are acceptable.
- E. Steam Kettle -OR- Tilt-skillet - Vulcan Model GL-30 with 2" drawoff, 105,000 BTU. Equal units by other manufacturers are acceptable. Coordinate water supply hook-up.
- F. Serving Counter - 14-gauge stainless steel top with 1/4" laminated safety glass sneeze screen. Provide with shelves and sliding doors, front, ends and balance of table to be 18 gauge galvanized steel. Provide tray rails along outside of counter. Unit to be 166" long x 30" wide x 34" high. Three to four steam table inserts per serving line. Sneeze guard to be set 8" above serving line to allow for serving of food underneath.
- G. Two-compartment Sink - Two in schools over 1,200 pupils. Each compartment 24" x 24" x 14" deep with 24" drain board on each end and 10" high back splash with 2" return to wall of 14 gauge stainless steel. Mixing faucet and lever-operated drain plugs. Provide 110 volt duplex outlet adjacent to sink and a chrome plated hose bibb in back splash as located by Owner.
- H. Three-compartment Sink - Each compartment is to be 27" x 24" x 14" deep with drain board on each end, 10" high back splash with 2" return to wall, of 14 gauge stainless steel. Mixing faucet and lever-operated drain plugs.
- I. Dishwasher - Free standing Hobart Model AM 14T, Class 3, natural gas booster heater (Vanguard model PowerPac #165), exposed top with rising doors to fit table arrangement. Not less than 16 gauge, #4 finish stainless steel, self-draining single tank, integral motor, thermal overload switch and pump, revolving wash and rinse arms; water level indicator; wash and rinse temperature thermometers, with thermostatically controlled tank heater; and time auto cycle. Coordinate rinse cycle specifications with Mechanical. Prefer to deliver 180 degrees to dishwasher rinse section by boiler system if feasible.

Provide conveyor type machine for secondary schools.

- J. Walk-in Cooler and Walk-in Freezer - Air-cooled, package unit. Give attention to noise of compressors. Units to have 96 square feet for high schools and middle schools and 64 square feet for elementary schools. Set unit in recess to keep floor flush with kitchen.

Entire cold storage area to conform with NSF Standard #7.

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Provide 4 high - 18" deep adjustable metal shelves on three walls and include Dunnage racks.

- K. Dry Storage Space - Provide 5 high 18" deep fixed metal shelves. Shelves to allow for stacking #10 cans; 70 to 80 lineal feet of shelf required.
- L. Kitchen Hoods - not less than 6'-6" above the floor. – “Smart Hoods” preferred. Coordinate with Mechanical design. Hoods must have dampers to prevent outside air from down-drafting into the Kitchen area. Coordinate with the Mechanical designer on the use of Class 1 and Class 2 hoods.
- M. Auxiliary Heater – See mechanical for gas-fired auxiliary water heater.
- N. Fire Suppression System - Provide a complete Ansul System, with all code-required gas line and exhaust fan interlocks.
- O. Floor Sinks – Carefully coordinate locations with equipment plan.
- P. Equipment Manufacturer – Utilize Hobart kitchen equipment where possible.
- Q. Extended Warranty – Consult with Owner regarding bid-alternate provisions for one (1) year extended warranties. Include all major equipment including ovens, fryers, refrigerators, and freezers.
- R. Residential Appliances – Where required at staff lounges, lab and prep rooms, and health rooms, appliances shall be purchased by Owner and installed by Contractor. Range hoods shall be provided and installed by Contractor. Coordinate type with District Facilities Department.

<<<<END OF DIVISION 11>>>>

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DIVISION 12 - FURNISHINGS

I. CASEWORK

- A. All casework should be by a Manufacturer approved by the district.
- B. Consider the option of thermally fused Melamine at vertical surfaces.
- C. Specify in detail the following:
 - 1. Workmanship
 - 2. Materials - thickness, grade, etc. for high-pressure plastic laminate, hardware requirements and manufacturer.
 - 3. Construction
 - 4. Installation
- D. Countertops and backsplash shall be 1 " thick medium density particleboard with high-pressure plastic laminate finish (.050" thick). All exposed edges shall be edged with 3mm PVC applied with hot glue. Consider ¾" thick back. Particleboard: Be specific as to exact type required, referring to ANSI 208.1. Avoid use of products containing urea-formaldehyde. Consider use of wheat board and other low-VOC materials.
- E. All cabinet drawers and doors (except sink base cabinets) in general office area, nurse's area, and audio-visual storage areas in elementary schools should have locks. One cabinet drawer and teachers closet door in each elementary classroom shall be locked. All cabinet drawers and doors (except sink base cabinets) in middle and senior high schools should have locks. Verify keying with Owner, but in general all cabinets in any one room shall be keyed alike. Assemble all keys with keying schedule and turn over to Owner's representative.
- F. Custom made cabinets may be considered if quality and cost are approximately equal to pre-built cabinets.
- G. Particular attention shall be given to detailing and hinges of large instrument and general storage cabinets. Use continuous hinges where necessary to support weight of door under heavy use.

II. STAGE DRESSINGS

- A. Stage dressings, including certain track and draperies shall be included as part of the general contract.
- B. Provide structural supports for stage dressing in appropriate section of specifications. Supports shall be designed for anticipated loads and be properly braced.

III. ATHLETIC EQUIPMENT (ELEMENTARY SCHOOLS)

- A. Basketball backstops – Main Court. Porter No. 90949 or approved substitute. Vertical adjustment from 8' to 10'. Folding backstops shall be operated by remote electric winches complete with safety straps and hoist cable retractor. Check Model Numbers

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- B. Basketball backboards – Side Courts. Porter 0028-300 rectangular wood bank or approved equal.
- C. Climbing ropes - Porter No. 114 or equal, 3-strand hemp with leather booted end. Bottom to hang 6" above finished floor.

IV. ATHLETIC EQUIPMENT (MIDDLE AND SENIOR HIGH SCHOOLS)

- A. Basketball backstops – Main Court. Porter No. 90917 or approved substitute. Folding backstops shall be operated by remote electric winches complete with safety straps and hoist cable retractor.
- B. Basketball backboards – Side Courts. Porter 0028-300 rectangular glass bank.

V. SHOP EQUIPMENT AND INDUSTRIAL TECHNOLOGY EQUIPMENT

- A. Owner-furnished shop and industrial technology equipment should be mounted to the floor and wired as part of the construction contract.

VI. LABORATORY TOPS AND SINKS

- A. Shall be acid resistant epoxy resin with epoxy resin sinks as required by program.
- B. Shall be compatible with the height and requirements of other lab equipment.

VII. GRATES

- A. At main entrances shall be recessed and set in aluminum frame.

VIII. ATHLETIC SCOREBOARDS

- A. Secondary schools, as manufactured by Nevco. Scoreboards shall accommodate basketball, wrestling, and volleyball. Alternate equipment must be fully compatible with Nevco.

IX. GYMNASIUM BLEACHER

- A. Shall be equal to Hussey Model 2600 or approved substitute. Consider the use of plastic integral color seats in lieu of wood. Bleachers shall be motorized in operation and shall include provision for ADA block-outs at main floor level.

X. ART ROOMS

- A. Shall provide adequate room for flat and disposable product storage.

XI. SINKS

- A. Shall be stainless steel, mounted in a solid surface or stainless steel counter assembly.

<<<<END OF DIVISION 12>>>>

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DIVISION 13 - SPECIAL CONSTRUCTION

Not used.

<<<<END OF DIVISION 13>>>>

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DIVISION 14 - CONVEYING SYSTEMS

- I. In new buildings, where elevators are necessary, specify standard hydraulic commercial elevators with 2,000-lb. capacity, as manufactured by Dover, Montgomery, Otis, or Schindler.
- II. If storage areas utilize crawl space or basement, locate elevator to provide access to this level.
- III. In remodeled buildings, where vertical transportation is required for ADA purposes, standard commercial elevators with 2,000 lb. capacity are preferred, but consult with Facilities Department for possible use of vertical access lifts, for low-demand usage. If vertical access lift is chosen, it shall have a 750-lb. minimum capacity.
- IV. Key operated controls for building elevators are required.
- V. Emergency telephones in elevator cab shall be coordinated with building communication/phone system.

<<<<END OF DIVISION 14>>>>

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DIVISION 15 - MECHANICAL SYSTEMS

I. GENERAL

A. General Procedures:

This section contains guidelines for general mechanical systems. Design Team shall fully coordinate these requirements with other Specifications sections such as Divisions 1, 2, 11, and 16.

Terms used herein shall have the following connotation: Will, provide, shall, must: an absolute requirement. Preferred or desired: this indicates Owner's preference if other conditions are about equal.

To obtain variance from these guidelines, send request in writing to School District Facilities Department, for approval prior to designing or specifying them.

Asbestos shall not be used in any part of the mechanical systems, including insulation or boiler gaskets.

Solder containing lead shall not be used anywhere in the building, and if any lead is found, require that all solder joints shall be replaced at Contractor's expense.

Functions and educational requirements as pertaining to mechanical systems are described under General Requirements and Room Requirements listed herein. The design engineer shall review these sections carefully to establish intent and scope of educational function for each area.

The following design criteria and recommendations summarize the various engineering aspects of planning, design, installation and maintenance which are to be considered in achieving the following objectives:

1. Maximum safety.
2. Performance and reliability.
3. Cost (amortized, including initial, operating, maintenance, etc.)
4. These criteria, coupled with specified educational and functional requirements, form the basic guidelines for mechanical planning. They are not intended, however, to restrict the design team in the application of other concepts that are consistent with the educational and functional needs and the objectives listed above ~~There is a basic need for mechanical system flexibility, especially with regard to space provisions for serving additional (future) uses such as closed circuit and commercial television, computer systems, communications, etc.~~

B. Mechanical Design Criteria.

Functions and educational requirements as pertaining to mechanical systems are described under General Requirements and Room Requirements listed herein. The design engineer shall review these sections carefully to establish and intent and scope of educational function for each area

C. Comply with the following as a minimum:

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1. International Energy Conservation Code
2. International Plumbing Code
3. International Mechanical Code
4. Colorado Department of Labor and Employment regulations
5. ASHRAE 90.1-current version.
6. International Building Code
7. Colorado State Boiler Code
8. Colorado Department of Health Regulations
9. NFPA 5000 Standards
10. International Fire Code
11. Local Codes or standards as applicable; including Fire, utility regulations, etc.

- B.D. Access:** Provide access to all valves and equipment, including filters. Provide access doors in ducts on both upstream and downstream sides of heating coils to allow for cleaning of coils. Whenever possible, locate equipment in hallways for maintenance access.

Arrange piping and ductwork to not block required access to equipment for servicing and maintenance.

Whenever possible, locate serviceable equipment (terminal heating, VAV, etc) in corridors and areas where maintenance activities do not affect classroom or office functions.

- E. **Remote Metering:** Make provision for communication from the gas service meter to remote readers. Coordinate with utility company and Owner for requirements. Provide for meter to be read through BAS equipment (Division 16, Section III, Paragraph D)
- F. **Mechanical/Electrical Coordination:** See Electrical Division 16 Section III, paragraph D for power requirements and wiring coordination.

II. VIBRATION ISOLATION

- A. Provide vibration isolation for motor driven equipment, connecting piping, and/or ductwork in accordance with manufacturer's recommendations and ASHRAE applications guidelines.
- B. Whenever possible, locate air handling equipment over hallways, restrooms, storage areas and other similar areas to minimize vibration in occupied areas.
- C. Consider separate ground-mounted auditorium units.

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- D. Refer to structural.

III. MECHANICAL INSULATION

- A. Insulation shall be standard brands with proper flame-spread ratings, having no asbestos content. Flame spread rating shall not exceed 25 and smoke developed rating shall not exceed 50. Insulation shall meet the requirements of NFPA 90 for fire resistance.
- B. Choose insulation type and thickness based on the International Energy Conservation Code to maintain operating economy; to prevent heat gain or loss into unoccupied areas; to prevent condensation damage; and to prevent freezing. Provide vapor barrier on insulation of cold pipes and ducts.
- C. Normally, insulation will be required as follows:
 - 1. Heating ducts: External duct insulation preferred.
 - 2. Cooling ducts: External duct insulation preferred.
 - 3. Evaporative systems shall have only exterior insulation.
 - 4. Fresh-air ducts: External duct insulation preferred.
 - 5. All heating piping.
 - 6. All hot water and condensate vessels.
 - 7. All domestic hot water supply and recirculation lines.
 - 8. Domestic cold water lines.
 - 9. All chilled water lines.
 - 10. Boiler room breechings, stacks, etc. where required.
 - 11. Refrigeration suction piping.
 - 12. Condensate drain piping.
 - 13. Above ground rainwater piping and roof drain basins where required.
 - 14. Handicap accessible fixtures per code.
 - 15. Provide jacket or shell on exposed insulation – either aluminum or stainless steel.

IV. FIRE PROTECTION

- A. New buildings and additions to sprinklered buildings shall be fully fire-sprinklered in accordance with jurisdictional fire department. Consult Facilities department for other

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requirements. Take prudent design precautions in areas subject to freezing. Avoid locating fire lines under or sprinkler heads near combustion air inlets.

- B. Kitchens may require fire suppression system at range hoods. Consider both Class 1 and Class 2 hoods.
- C. Maintain and consult NFPA, International Fire Code, and local jurisdiction regulations.

V. PLUMBING

A. General.

- 1. Provide for servicing of lines and equipment, including adequate cleanout access.
- 2. Coordinate with Architect for occupant load for number and size of fixtures, and Food Service requirements.
- 3. Avoid locating domestic water lines under or near combustion air inlets or other location subject to freezing..

B. Utility Connections.

- 1. The Design Team is responsible for determining requirements for local utility providers including submittal documents, taps, fees and licenses, meters, pressures, etc. The Design Team will determine required meter locations, requirements for separate taps or combined taps, and other specific requirements of all local utility providers for each project.
- 2. The Owner will make all arrangements for taps, tap fees, payment guarantees, etc., for permanent utilities. The construction contract shall include the actual cost of taps, meter installation, and piping to the building. If utilities are not in adjacent streets or roads, contact the Owner for instructions.
- 3. Water meter pit and meter for domestic (potable) water shall normally be separate from meter pit and meter for irrigation water. Provide School District service valves in each meter pit. Do not increase tap size for irrigation needs. Provide for digital metering of water consumption.
- 4. Make direct contact with utility companies to determine piping, valving, pressure reduction and meter requirements. Determine water pressure available at the site prior to design.
- 5. Local utility provider charges for work on the property shall be included in the construction Contract, when possible. Other charges will be reviewed with the Owner and further negotiated by the Owner.

C. Future Utility Expansion.

- 1. Consider future additions when sizing utilities. See specific program for project, and consult Facilities Department.
- 2. Provide future utilities in location designated by the Facilities Department for future modular buildings. Specific site requirements for modular facilities shall be

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reviewed with the Design Team and the Owner's Auxiliary Services Department in the Schematic phase. These shall include but not be limited to the following:

- a. Domestic Cold water.
- b. Sanitary sewer.
- c. Gas line.
- d. A separate 1" conduit for future DDC temperature cables per double classroom portable. Route conduits back to building's main temperature panel room and clearly label each function to facilitate future connection.
- e. Fire Alarm conduit shall be provided separately as required by the most stringent Codes. .
- f. Domestic cold water shall terminate with the location and depth accurately located on record drawings. Provide shut-off valve inside building. Domestic cold water shall be a minimum 4'-0" below grade.
- g. The as-built locations of all the above utilities shall be measured to a +/-6" accuracy in two directions to the centerline of the pipe below grade. Measurements shall be taken from building lines, exterior walls, or poured concrete walks. All measurements shall be shown on the as-built plans. This is a requirement for final payment.
- h. See also Division 16 of Technical Guide for utility expansion for electric service, clock/bell wiring, security systems, temperature sensing, fire alarm systems and computer network systems. It may be practical to combine these, and above mechanical connections within the same chases or trenches.

D. Piping.

1. Domestic Water System
 - a. Underground piping including service shall be either PVC with bid alternates for ductile iron or type "K" copper with silver solder. Design piping system to eliminate or minimize any piping joints under slabs. Minimum cover 4'-0".
 - b. Protect domestic water supply from freezing. Exercise care to avoid outdoor air intakes, combustion air dampers, garage doorways, or other external freeze exposures.
 - c. Piping within building, Type L copper with 95/5 lead free solder joints. No galvanized steel piping will be permitted. All piping to be above grade or in accessible trench. No piping in exterior walls. Make sure that any piping above ceilings is on room side of insulation and adequately protected from freezing.
 - d. Provide isolation valves at all main branches and for all fixture groups.
 - e. Provide dielectric fittings where any dissimilar metals join. Avoid the use of dielectric unions in hydronic heating systems.
 - f. Provide shock absorber for all piping serving flush valves, solenoid valves, and other quick-closing valves. Provide isolation valves at each shock absorber for servicing.
 - g. Grooved mechanical couplings or joints shall only be allowed in accessible locations.
 - h. Domestic hot water
 - 1) The source of domestic hot water shall be the condensing boiler with separate storage tank. Boilers and tanks shall be sized as required for storage and recovery rates. Tanks shall be glass lined and carry a 5-year warranty. Provide separate loop with equal to or greater than 180° water to the kitchen dishwasher rinse cycle and temper to 140 degrees for kitchen sinks. Design separate building loop; and deliver 110°

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- water to the rest of the building, except Kindergartren and Pre-school fixtures shall not exceed state standards (all temperatures Fahrenheit).
- 2) Instantaneous gas-fired water heaters may be considered for energy efficiency.
 - 3) Use brass nipples and unions on water heaters.
- i. Provide pumped recirculation system.
 - j. Install piping to allow for expansion and contraction without stressing piping joints or connected equipment. Mechanical expansion devices shall not be used without District approval.
2. Soil and Waste Piping
- a. Soil pipe and soil-pipe fittings - extra heavy bell and spigot cast iron or equal, coated inside and outside with coal tar varnish for all waste lines below grade. Standard service weight cast iron may be used above grade. Acid-resistive waste and vent lines may be required for lab service areas. Duriron pipe and fittings is acceptable for both below grade and above grade piping. Fuse seal or equal polypropylene pipe and fittings is acceptable for above grade piping upstream of neutralization basins.
 - b. Waste lines above grade up to and including 2-½" to be cast iron. No galvanized steel piping shall be permitted. All exposed waste lines from fixtures shall be chrome-plated brass.
 - c. Vent piping above ground 3" and over to be cast iron or copper DWV. No galvanized steel piping shall be permitted.
 - d. Vent piping above grade up to and including 2-½" to be same material as waste lines. Vent pipe should project one foot above roof with vandal-proof cast iron vent cap such as Zurn or Smith. Provide increase in size for vent through roof in accordance with code, minimum size 3". Vent piping penetrating roof areas shall be designed to maintain integrity of the roof assembly.
 - e. Contractor shall install sanitary sewer service, including necessary manholes, on school property. Negotiations for the sewer tap, including the tap fee, will be by the School District. Cleanouts to be provided at 50' on center. Minimum cover 4"-0". Designs should satisfy local utility regulations.
 - f. Where sanitary sewer service is not available, the Architect shall design private disposal system in accordance with local health code requirements. If required, investigate self-contained packaged sewage disposal systems.
 - g. Ensure that all cleanouts are accessible. In exterior sewer lines cleanouts shall be at maximum 100 foot intervals, with manhole access at street. At the 5-foot sewer stub-out from the building, provide 2 cleanouts, one going in each direction.
 - h. Ensure that kitchen floor drains are located near work areas. Coordinate drain locations with kitchen designer.
 - i. For eye wash and shower stations, ensure that drain is located properly and that floor system is constructed to provide positive drainage. Locate drain piping discharge to prevent water from reaching wall and guide toward drain.
 - j. Group toilet, shower, locker, and kitchen area drains shall ensure that drain is located properly and that floor system is constructed to provide positive drainage. Locate drain piping discharge to prevent water from reaching wall and guide toward drain.
3. Tests for Domestic Water and Drainage System Piping.
- a. The Owner's Representative shall be present to witness all tests and documentations.

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- b. All hot and cold domestic water lines shall be capped or plugged and tested with 100# hydrostatic test. They shall be proved tight before any piping is covered or concealed in any part of the building construction.
 - c. All soil, waste, storm, and vent cast iron sewer piping occurring inside the buildings shall be hydrostatically tested at 10 PSI and all the joints inspected while under pressure.
 - d. All soil, waste, storm and vent piping which occurs outside the building area will be tested to a minimum of 10 feet of pressure head. Each joint shall be water tight after 15 minutes.
4. Gas Piping
- a. Gas piping shall be installed in strict accordance with the NFPA 54, latest edition.
 - b. Shut-off valves shall be installed in the main supply to each appliance.
 - c. Electrically operated emergency shut off solenoid valves shall be installed in the supply to any room supplied with gas so that the entire gas supply may be stopped to the area. This valve will be controlled by a key operated switch located adjacent to the exit.
 - d. Dielectric fittings shall be installed at the meter if the project contains underground gas piping. Cathodic protection of the underground piping may be necessary and should be investigated with the specific soil analysis available for the project site.
 - e. All underground gas piping outside of buildings should be polyethylene pipe. Fittings and all joints shall extend not less than 6 inches past and end of the fitting onto the pipe section. All testing of pipe and fittings shall be done prior to wrapping the fittings. Follow manufacturer's recommendations as to priming, tape widths, etc.
 - f. Where approved by Owner gas piping run across roofs should be mounted firmly on and attached to min. 18" sections of Enrico foam blocks, Trex, or other approved method. Piping shall be designed to accommodate thermal expansions.
 - g. Gas piping under floor slabs, inside of building, shall not be used, even if vented sleeves are provided, except, with specific written approval by the Owner at certain science room locations. Any tunnels or shafts containing gas piping shall be vented.
 - h. Plenum gas routes shall be welded.
 - i. ASTM-A106 Welding fittings should be used on all gas piping 2" and larger.
 - j. The natural gas service will be negotiated by the School District; the Architect should provide necessary data for said negotiations. The Utility Company shall install these services to and including the meter. Meter shall be enclosed by a fence (reference Section 2.E.5). Provide for digital reading of the meter.
 - k. Gas Pipe Testing - All gas pipe shall be subjected to a visual soap test while holding 100 psi air pressure. In lieu of the test the Contractor may use a 30 psi gauge test for 24-hours, showing no pressure drop except as obtained by temperature changes.
 - l. The Owner's and Architect's representative should be notified prior to testing gas lines so they may be present.
 - m. At kitchen appliances, where Health Department may require moveable appliances with approved flexible gas connectors, alert Architect and Food Service consultant that a means must be provided to temporarily secure these appliances to the wall or floor, by means of latches, brackets, etc.
5. Lawn Sprinkling and Wall Hydrants

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- a. Provide freeze-proof box-type wall hydrants or sillcocks with vacuum breakers on building, served by sprinkler system beyond walks, no greater than 100' O.C. around building perimeter for hand hose watering near to building. Provide sillcocks for washing paved areas at all main service and pedestrian entrances.
 - b. Provide separate water meter for all exterior irrigation and cooling towers on site.
6. Fixtures (See architectural guidelines for fixture mounting heights.)
- a. All exposed supply and waste piping to fixtures shall be chrome-plated brass.
 - b. All fixtures shall have stop valves. All fixtures shall be provided with vandal-proof aerators, etc.
 - 1) Fixture Types - the following are typical and intended to indicate style, quality and cost level. These fixtures and fittings are to be furnished as a minimum facility.
 - a) Water Closets (wall hung): For students and public use, install vitreous china siphon jet elongated bowl, chrome cap nuts, solid plastic open-front white seat, diaphragm type flush valve with vacuum breaker, 1" screw driver stop and flush connection with protecting cap, 3" metal oscillating disc handle. Use appropriate carriers. Specify Sloan Flushometer valves.
 - i) Verify height of fixtures for disabled persons.
 - ii) In administrative and faculty areas, quiet action is essential. Vitreous china siphon jet elongated bowl built especially for quiet action flush valves; solid plastic open front white seat; 1" screw driver stop, 3" metal oscillating disc handle. Where water supply pressure or flow is not adequate for flush valves, install elongated siphon jet bowl and tank combination with tank cover locking device; solid plastic open-front white seat.
 - b) Urinals - Vitreous china wall-hung, washdown type with integral strainer, diaphragm type flush valve with 3/4" screw driver stop, 3" oscillating disc handle, Sloan Flushometer. Set 16" floor to lip in elementary schools. Twenty inch (20") floor to lip in middle and senior high schools. Trough urinals shall not be used. Spacing shall provide 6" minimum between urinals. Verify mounting height of fixtures for disabled persons.
 - i) Consider waterless urinals.
 - c) Lavatory - Vitreous china except as otherwise noted.
 - i) In all schools for student and public use, include concealed arm carriers. Provide required fixtures and trim for handicapped access. Electronic faucets in areas as approved by the District.
 - ii) Wall-hung, no carriers, but with pop-up waste for faculty and administrative areas. Handicapped access should be provided.
 - iii) Wall-hung, faucets with wrist control handles and open strainers in kitchens and health rooms, 31" floor to rim. Handicapped access should be provided.
 - iv) Provide screwdriver stops, vandal-proof aerators, cast brass P-traps with cleanout for all lavatories.
 - v) All lavatory faucets shall be at 4" centers.

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- d) Stainless steel sinks for counter top installation shall be self-rimming type. Specify minimum 18 gauge sinks, fully undercoated with sound deadening material. Factory punching shall be specified to accommodate fittings specified.
- e) Service Sink - Floor-type preferred in all schools, terrazzo or molded stone floor service sink with rim guard and strainer; exposed double faucet with integral stops, hose and spout, bucket hook, and vacuum breaker. Mount faucet trim 24" above floor.
- f) Drinking Fountains - Fountain for general usage. Shall be of the one-or two-bubbler type, wall-hung or recessed, anti-squirt bubblers with automatic volume regulators, self-closing valves, and cast-brass trap with cleanout. Set 24" floor to rim in elementary schools; 30" floor to rim in middle and high schools. There shall be no bubblers or drinking facilities in toilet rooms. Furnish with screwdriver stops. All drinking fountains shall be handicapped-accessible. Provide at least one refrigerated water cooler per floor, one in the cafeteria area, and one in the lobby area. Fountains shall be box-type with attention given to proper support and vandal resistance. Consider bubblers on K- and pre-K sinks. Toilet Room Hose Bibbs - In each group toilet room, furnish a lockable box-type chrome, vacuum breaker hose bibb installed under a lavatory on the hot water supply
- g) Wall Hydrants - Wall hydrants shall be ¾" cast brass of the non-freeze type with a galvanized wall sleeve, loose key handles with service valve.
- h) Roof Top Hydrants - For buildings with air handling units on the roof, provide freeze-proof hot and cold water hydrants.
- i) Floor Drains - to be cast iron with removable grids compatible in appearance with the area involved. Provide floor drains in all toilet rooms, including consideration of individual faculty toilet rooms.
 - i) Traps may be integral or provided in waste lines. Floor drains to receive flashing shall be specified with flashing flanges.
 - ii) Drains above grade to be flashed with 4# sheet lead 24" x 24".
 - iii) Provide floor sinks or drain trenches in Boiler Room, for draining mechanical equipment, with minimum 3" waste line.
 - iv) Provide floor drain at air compressors for condensate drain on dryers, within 2 feet of unit.
 - v) In rooms with ceramic tile floors specify square top drains for neat installation.
 - vi) Provide specialty traps and interceptors in Art rooms where applicable.
- j) Roof Drains - to be cast iron with gravel stop; weep holes, low dome with a flashing clamp. Call for 30" x 30" flashing. Roof drain type and flashing shall be coordinated with roofing system being provided or roof assembly compatible with flashing seal.
- k) Roof Flashings - All plumbing pipes passing through the roof shall be flashed extending up around the pipe and over and down inside the pipe at least 1". The base of the flashing shall be 24"

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x 24" on the roof. Roof drain type and flashing shall be coordinated with roofing system being provided.

- l) Grease Traps - are to be installed for all kitchens where required by Code. Install outside building wherever possible.
- m) Provide for sand and oil interceptors in auto shops and parking garages.

VI. MECHANICAL IDENTIFICATION

- A. All heating supply and return, domestic hot water and gas piping, where exposed to view, and above accessible ceilings shall be identified by color coding as follows:
 - 1. Color bands of identification may be painted on, or use colored tape for banding the pipe. The tape shall be guaranteed. National Emblem Company tape wrapped one and one-half times around the pipe may be used in lieu of paint. Apply at walls, floors, ceilings, and 50-foot intervals.
 - 2. Directional flow arrows shall be included with the color code, painted on the pipe or insulation using a stencil.
 - 3. All color coding shall be in accordance with the latest issue of the ASHRAE Fundamentals Handbook Chapter 34 recommendations, based on the "contents" of the piping.
 - 4. Reference Section 15995, Maintenance Manual and Guarantee for tag and identification specifics. (Cross-check reference)
 - 5. Nameplate requirements. Nameplate information shall be permanently affixed to each piece of equipment.
 - 6. All mechanical equipment shall be identified in the field by name and number utilizing permanently affixed labels or painted stencils at least 3" high and located in an easily viewed place. This shall apply to all air handling, exhaust, boiler, chiller, pump, and other major equipment components.
 - 7. Stamped valve tags preferred.

VII. HEATING, VENTILATING, AND AIR CONDITIONING – GENERAL

- A. See General Section for additional requirements.
- B. System Types.
 - 1. Mechanical or indirect evaporative cooling may be used on designated projects. Kitchens may utilize direct evaporative units.
 - 2. Air- side or water-side economizers shall be required for all systems.
 - 3. All systems should provide positive ventilation. Ventilation shall be provided to comply with the requirements of ASHRAE Standard 62. Air flow and sizing of

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HVAC equipment and duct work shall be based on quantities required for ventilation not just for heating.

4. Heat source should be a central hot water system. Direct fired heat exchangers should not be used without the permission of the School District. The district prefers 'Condensing' boiler plants. Such plants operate most efficiently with high 'delta-T' return temperatures to the boiler loop. Designers should be careful to appropriately size coils to extract the maximum heat per the boiler manufacturer's recommendations. Domestic water pre-heat and other considerations should be made to utilize return water heat.
5. Basic heating and ventilating equipment may be of the central station unitary type.
6. Supplemental heating may be unit heaters, cabinet heaters, radiation, etc.
7. Electric heat shall not be used, unless by approval of Owner.
8. When air conditioning is required, consider using indirect evaporative pre-cooling and ice storage. Water-cooled chillers are preferred over air-cooled chillers. Chilled water is preferred over DX. Identified sub-loads for seasonal employees (summer) may consider DX for offices and similar small areas. The higher of IECC or Energy-Star rated equipment is preferred
9. Direct evaporative cooling systems are unacceptable, except for kitchens.
10. The district encourages the investigation and will consider the installation of alternative technologies. Rough marginal costs are required (to compare to traditional design).
11. Mechanical designs should be coordinated with the district Energy Program.
12. The district requires rated premium-efficiency motors, and encourages VFD use to match motors with actual loads.

C. General Design Considerations.

1. Adequate space must be given to accessibility and servicing of equipment, including filter changing, equipment replacement, and major repairs. All equipment must be installed so that it can be serviced and repaired as recommended by the manufacturer (e.g., access panels must open fully, filters must be replaceable without bending, etc.).
2. The District encourages Schematic Design consideration of resource efficient alternates – GSHP, Condensing Boilers, Chillers, Cooling towers, VAV, High efficiency motors, VFD, high SEER equipment (Energy Star standards), etc.
3. Coordinate with energy team and district energy standards in developing schematic designs.
4. Wherever possible, specify equipment that has low routine maintenance; e.g., exterior grease fittings, etc.
5. All 3-phase motors 1 HP or larger shall have phase protection.

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6. All 10-HP and larger motors shall include integral capacitors, high Power Factor, or other technology to maintain high Load Factors for soft-start and energy conservation purposes. << Bill suggests language requiring electrical designer to include distribution panel-level capacitors>>
 7. Unit ventilators, unit heaters and cabinet unit heaters shall have direct drive motors. Consider location of units with respect to air distribution, noise, and service access.
 8. Consideration must be given to equipment noise and vibration isolation, especially when equipment is mounted above grade. Consideration must also be given to locating equipment away from quiet areas and classrooms.
 9. Provide sufficient isolation valves and unions to allow parts of the domestic water or hydronic heating system to be serviced without disabling other parts of the system. This shall include each piece of equipment, such as pumps, unit heaters, radiation units, coils, heat exchangers, etc. Past experience has shown that unless these are individually shown (even though they may be specified), most contractors will not provide them.
 10. No system shall have control voltage exceeding 120 volts (24 volt preferred).
 11. Indirect evaporative coolers used with air handling units shall have access doors for pad removal as large as the pads which are to be serviced. Water tank, pad rack, or any area downstream from pads shall be of a rust-resistant metal such as galvanized, stainless, etc. Consideration should be given to electrostatic type powder coatings. Indirect evaporative cooler systems must be specified with water treatment and treatment monitoring systems to prevent water and air quality problems.
- D. Zoning. The heating and A/C system shall have separate air handling systems and shall be zoned according to direction and severity of exposure and occupancy and use of space. In addition, the following areas shall have individual air handling control: << See also XIII, 15)>>
1. Individual classrooms (VAV)
 2. Office and combined office/conference areas (VAV)
 3. Media Center (VAV)
 4. Entries
 5. Cafeteria (VAV)
 6. Auditorium
 7. Gymnasium
 8. P.E. Locker Rooms
 9. Large Music areas
 10. IT closets (consider split systems)
 11. Computer Labs (consider split systems)
 12. Large electrical rooms (consider split systems)
 13. Other areas subject to special uses and occupancy

VIII. CHEMICAL WATER TREATMENT

- A. Provide chemical water treatment for:

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1. Hot water heating systems.
 2. Chilled water systems.
 3. Condenser water systems (cooling towers).
 4. Steam systems.
- B. Owner performs chemical treatment maintenance. Provide systems in conjunction with: Owner-provided vendor information. Contact treatment provider for specification relating to systems design.
- C. Glycol concentration: 25%. Use propylene glycol only. Consult with Owner regarding alternatives for ethelene glycol.

IX. HEAT GENERATION

A. Heating Piping.

1. Normally, black steel with cast iron screwed fittings for 2" and under, black steel with welded fittings above 2". Weld-O-Lets and Thread-O-Lets may be used for take offs, mitered tees not allowed. Type "L" copper with 95/5 solder joints may be used between sections of fintube and may be allowed as a Contractor's option. If at all possible, do not use dielectric unions in closed loop hydronic heating systems; if they are absolutely unavoidable, provide valve on each side of union and provide high temperature gaskets. Steam condensate lines shall be either wrought iron or a suitable corrosion resistant alloy.
2. Piping shall not be installed under slabs unless in an accessible trench.
3. Piping shall not be installed in exterior walls.
4. Piping above ceilings shall be on the room side of the building insulation and shall not be installed adjacent to exterior walls or in soffit without special precautions against freezing.
5. Radiant slabs shall not be used without special permission, and shall not be used in structural floors.
6. Provide for drains, isolation valves, air vents, etc., as required for maintenance of system. Use manual air vents unless automatic vents are absolutely necessary.
7. All equipment; pumps, coils, sections of radiation, etc., shall be provided with shut-off valves.
8. Provide for system balancing and balancing valves in fixed-flow systems. Where practical, provide Venturi flow meters, etc. for flow measurement in mains and zones of building, Reference Section 15990. This provision does not apply to variable-speed drives.
9. Valve main heating lines from Boiler Room into quadrants, or some reasonable division, to permit partial draining of boiler water, for repairs, without the necessity for replacing all the boiler water treatment and/or glycol. Allow for piping expansion and contraction without stressing pipe, joints, or connected equipment. Mechanical expansion compensation devices shall not be used without District approval. Use

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bottom take-offs for branch piping wherever possible to avoid trapping air. Maximum velocity 5 feet per second.

10. All piping components shall be stored in protected areas where dirt and debris is prevented from contaminating the pipes. Keep coils wrapped and sealed until installed in place to prevent contamination.

B. Boiler Plants. (Ron needs to review – valve and flame failures, condensing boiler specifications)

1. Boiler rooms should be on the first or ground floor. Direct access to the outdoors for equipment access and maintenance is desirable. Provide doors large enough to pass replacement equipment without demolishing walls. Space above boiler room shall not be used for human occupancy. If boilers are to be mounted on structural floors special consideration must be given to the weight of the boilers and structural support in access path to the outdoors for servicing and replacement of boilers in the future.
2. Controls should be provided for automatic shutdown of boiler when outside air temperature warrants, and should be integrated into the DDC control system.
3. Allow space in the boiler room for make-up water chemical treatment. Include bypass chemical feeder and reduced pressure backflow prevention in contract. Backflow preventers shall be no more than 5 feet above floor level. Specify initial testing and certification of backflow preventers to be included in contract. A resilient seat spring-loaded check valve shall be installed directly ahead of backflow preventer. Pressure reducing valves for make up systems to be located downstream of backflow preventers. Glycol feeders shall be included for monitoring on the BAS.
4. Boiler types:
 - a. All boilers shall have automatic flue dampers where Code permits.
 - b. Condensing Boilers are required unless special circumstances exist.
Approved boilers include:
Aerco
Buderus – pending US approval
Viessman
Consider Hybrids – Gas Master
 - c. Induced draft fans shall not be used.
 - d. Do not use small package water tube boilers (including Lochinvar) unless approval is received in writing.
5. All boilers shall meet ASME Code requirements and shall have AGA approval where applicable. All installations shall comply with the State Boiler Code.
6. Boiler Startup. Boiler startup shall be by Manufacturer's Representative, and shall be scheduled with, coordinated with and witnessed by the Owner.
7. Glycol testing levels, chemical tests, and boiler startup Reports shall be presented to the Owner as a part of the O&M documentation.
8. Boiler Controls:
 - a. Up to 400,000 BTUH sea level input rating shall have UL approved control system. 400,000 to 1,500,000 BTUH sea level input rating shall have FM

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approved controls. Over 1,500,000 BTUH sea level input rating shall have FIA approved controls, intermittent auto pilots, and electronic flame supervision.

- b. All boilers shall have high temperature (or pressure) and low water cutoffs with DDC and local alarm indicating lights and manual reset.
- c. All boilers shall provide a DDC interface for flame failure.

~~7.9.~~ Boiler trim for water boilers shall include manual reset low water cutoff, manual reset high temperature limit, pressure gauge, thermometer, separate operating aqua stat, pre-wired control panel, and ASME relief valves.

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~~8.10.~~ Steam boilers are not encouraged. Boiler trim for steam boilers shall include two low water cutoffs, the lower secondary one of which shall have manual reset, test and check valves, high pressure limit, separate operating pressure switch, pressure gauge, water column with try cocks, pre-wired control panel, and ASME safety valve(s) with discharge piped to a safe place. Use automatic water feeders unless feed pumps have automatic standby pumps.

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~~9.11.~~ Do not use steam over 15 psig unless special permission is received in writing.

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~~10.12.~~ Pipe gas vents outdoors, not to burner.

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~~11.13.~~ Provide operating instructions on control panel.

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~~12.14.~~ Provide blowdown on low water cutoff (and water column).

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~~13.15.~~ Fuel: Natural gas wherever possible.

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16. Combustion air shall be provided as required by IBC, latest edition. Combustion air openings shall be provided with automatic dampers that open when boiler fires. A boiler circuit proving switch shall be wired in, to prove damper is open before allowing boiler to fire, per IBC. Mechanical or plumbing equipment that could freeze shall not be located near the outside air intakes.

17. Provide boiler room ventilation for temperature control. Do not use exhaust fans, supply fans may be used. Avoid freeze conditions including location of piping near ventilation openings.

18. Provide multiple boilers on installations of over 3,000,000 BTUH gross output (at altitude of project.) For larger installations review boiler options with Facilities Department.

~~17.19.~~ Size total boiler plant gross capacity at 100% of heating load at minus 5° F. plus 20% pickup factor. Provide load calculations on mechanical equipment schedules. Multiple boilers are required for redundancy. Suggested loads are 60%, for each boiler.

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20. Provide boilers rated for 50-lb. working pressure.

21. Provide thermometer on return piping directly before boiler.

22. Reference boiler reset controls section in specifications.

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C. Pumps.

1. Use parallel pumping on all main pump circuits. Provide standby pump with one automatic change over. Provide DDC alarm on standby pumps.
2. Pumps shall be 'Hi-efficiency' types. Energy-Star rated.
3. Pumps shall be located to pump away from boiler. Provide primary pumps as required by the manufacturer.
4. Provide strainers and check valves in pump discharge.
5. Mechanical seal pumps will be normally used. Bell & Gossett preferred; Grundfos not acceptable.
6. Call for gauges at intake and discharge of each pump, with isolation valves.
7. Utilize primary/secondary pumping where appropriate for flexibility and efficiency of operation.
8. Provide two heating water pumps each at 100% with automatic lead/lag sequencing.
9. Prefer variable-speed pumps for energy use optimization.

D. Equipment Room Miscellaneous Items.

1. Use ASME rated expansion tanks with diaphragm rated for glycol service.
2. Use ASME rated relief and safety valves, to be sized to Insurance Company requirements.
3. Provide adequate space for accessibility to tanks and for tank replacement.

X. REFRIGERATION

A. Mechanical Cooling.

1. For possible year-round scheduling, and/or on designated schools, provide mechanical cooling. The general system shall be similar to requirements of Heating and Ventilating systems. Consult with Owner.
2. The fresh-air requirement may be reduced to minimum code requirements when operating on the mechanical cooling cycle.
3. Carbon dioxide sensors are preferred to monitor for fresh air, maintaining an indoor Carbon Dioxide level no greater than 700 ppm greater than outdoor air.
4. Systems shall be designed so that no refrigeration is required when outside temperature is below 55°F, with an adjustable A/C lockout on OSA temperature.
5. Systems shall be capable of simultaneous heating and cooling. Heating-cooling changeover shall be automatic. Four pipe systems are preferred over 2-pipe systems.

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6. Routine maintenance is a primary factor in system choice up to 50 tons; e.g., air cooled condensers. Operating costs are a primary factor in system choice over 100 tons, e.g., water cooled central chillers. Mechanical consultants should perform a comparative costs and benefits analysis of this, and discuss with Owner before selecting system. On water cooled systems consider indoor sump for cooling tower freeze protection. On water systems, consider flat plate heat exchangers.
7. Computer labs shall be mechanically cooled. Separate or 'split' cooling systems are preferred for computer spaces.
8. Administrative office and Media Center areas shall be mechanically cooled, and shall be separate air handling systems.
9. Cooling towers are preferred to provide 'free cooling' when chillers are in use. Sub-meter water supply to cooling towers via BAS for separation from wastewater charges.

XI. AIR DISTRIBUTION

A. Ventilation.

All occupied spaces within the building shall be provided with exhaust fan whenever any space requires exhaust air only, the make-up air should be provided from other areas of the building. Provide access for maintenance and replacement of all ventilation equipment.

1. The air systems, supply, return, and exhaust shall be designed and balanced so that the building will have a slight positive pressure at all times.
2. Ventilation requirements should conform to the latest edition of IECC, IBC, ASHRAE Standard 62 and Colorado Revised Statutes. Those Requirements will be considered as minimum. Consideration should be given in special areas to increasing ventilation requirements, e.g.: science rooms, computer labs, art rooms, copy centers, welding shops, locker rooms.
3. Use prudent design precautions to prevent placing outside air intakes in areas that will not provide fresh outside air, e.g., bus loading areas, kitchen exhaust, etc.
4. Kitchen shall be exhausted by a kitchen hood. Preference is for 'smart-hood' design. The kitchen ventilation system must comply with the requirements of IBC. Direct-fire hoods may be considered in kitchen areas.
5. Air exhausted from toilet rooms, kitchens, teachers' work and rest rooms, copy rooms, shower and locker rooms, and science laboratories shall not be recirculated at any time to other areas.
6. All fans shall be mounted with vibration dampeners and/or isolators. Flexible connectors shall be included between all fans and connecting ductwork, if required.
7. In areas where noise must be kept at a minimum, such as classrooms, offices, and most other occupied areas, exhaust fans shall be sound attenuated. Sound is a consideration in selection of backdraft dampers.

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8. Provide dust collecting systems for shops in school buildings. Verify requirements with Owner. Recirculating systems are preferred.
9. All heating and ventilating equipment requiring filters shall be furnished with throw-away 2" pleated type. Contractor shall install a new set of filters at the time the building is accepted, and shall provide one additional complete set of filters at that time, for Owner's use.
10. Exhaust hoods for kitchen and shop areas shall have air volumes (CFM determined by the capture velocities as recommended by ASHRAE).
11. Copy rooms should have separate exhaust zones.
12. Provide slightly negative ventilation system for automotive shops, as compared with adjacent areas. Engine exhaust system should be considered.
13. Provide slightly negative ventilation for finishing room of wood, metallurgy and plastic shops as compared with adjacent areas. Design paint booth to OSHA and ASHRAE Industrial Standards. Provide for filters as required for shop equipment (see Division 15, Section XII *Air Filters*).
14. Provide for two 1-inch flex hose connections, direct to exterior, for gasoline engine exhaust in middle school technical arts shop.
15. Investigate requirements for special exhaust systems.
16. Provide for natural cooling and ventilation of kitchen dry storage room. Normal heat requirements of these rooms are low. Do not locate heat sources such as refrigeration compressors in these rooms.

B. Ductwork.

1. Sheet metal ductwork shall be fabricated and installed in accordance with the recommendations of the latest ASHRAE guide and SMACNA Manuals. Provide insulation of ductwork to reduce heat loss.
2. Do not call for or permit non-metallic duct, under any circumstances. Boots may be used on returns.
3. Adequately sized access doors shall be provided in all air handling units and ducts for coil and filter removal, motor and fan lubrication, etc. Access doors shall be provided in the ductwork of sufficient size to service fire dampers, filters, etc. Provide access doors at both upstream and downstream side of each heating or A/C coil.
4. Where ducts pass through walls or partitions, the openings shall clear the metal of the duct by 1". Provide for support sleeves through masonry floors, walls, and ceilings. Where walls or floors are fire and/or smoke rated provide fire rating of penetration where it is necessary to make a change in the elevation of a duct, the change should be made as near a 30° angle as possible
5. Show locations and sizes of access panels on drawings.

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6. Call for range hood exhaust ducts to be welded throughout with approved fire block insulation or 1-hour separation , in accordance with most current NFPA.standards.
7. Do not call for exposed ductwork on roofs.

C. Ductwork Insulation.

1. External duct insulation is preferred to duct lining in all applications.
2. Do not call for any internal duct lining of supply ducts for direct evaporative cooling.
3. For acoustical isolation and sound attenuation, provide sound attenuators specifically designed for the application.
4. Study special occupancies for acoustical needs; e.g., band and music room, conference rooms, air transfer from cafeteria to kitchen, etc.
5. Avoid locating equipment over or next to quiet areas, including over classrooms.

D. Air Devices.

1. Grilles and registers shall not have removable cores unless job conditions warrant their use.
2. All supply devices shall have foam rubber or plastic gaskets around their outer frames or borders to prevent air leakage.
3. Supply grilles shall be of the double deflection blade type. The supply registers shall also have removable key operated opposed blade volume dampers for flow control.
4. Exhaust and return grilles and registers shall be of the fixed-blade type. These devices shall be positioned so they cannot be "seen through." The exhaust or return registers shall also have removable key-operated opposed blade volume dampers for flow control.
5. Provide fire and/or smoke dampers as required by UBC, latest edition. They shall be U.L. labeled dampers or equal and bear labels of compliance with fire and/or smoke rating.
6. Provide heavy-duty solid bar grille or register in high activity areas such as gymnasium.
7. Ceiling diffusers shall be of the adjustable pattern type, with throw-patterns designed in response to space layouts.. Provide volume dampers for balancing in all duct systems.
8. Air extractors and/or distribution grids shall be used where air outlets are mounted direct on the ductwork. Where the branch or take-off collars are short, air extractors shall also be employed for better distribution across the outlet face.
9. Call for dampers having springs, pulleys, cables, and motor mounted outside of duct, for servicing, such as Prefco Products. Do not specify dampers requiring dismantling to service.

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10. Use most efficient air distribution layout and devices consistent with building design.
11. All 90° elbows up to 18" wide and all 45° elbows shall consist of an inside radius of not less than ½ width of the duct or shall be furnished with single blade duct vanes with 2¼" blade spacing.
12. Ninety degree (90°) elbows larger than 12" in either dimension shall be equipped with airfoil type duct vanes having an inside radius of 4½" and an outside radius of 2¼" and shall consist of Tuttle & Bailey Type D, Elgin Manufacturing Corporation vane runners or equal, 2¼" blade spacing.
13. Shop fabricated duct vanes shall conform to the latest details of the SMACNA Sheet Metal and Air Conditioning Contractor's Manual.

XII. AIR FILTERS

- A. Provide all new filters as 2" pleated filters, MERF-8 (or 11 for LEED) at startup.
- B. Provide for a clean set of filters to be installed in all air handling equipment VFD's, and other filtered components when the Owner accepts project, plus one (1) full replacement set for maintenance purposes.
- C. Equipment shall not be operated for any reason without filters in place.

XIII. CONTROLS

A. General.

1. The System. The School District has an established District-wide Automated Logic central Control and Building Automation System. All new buildings and additions or remodeling shall continue and become a part of this system. The installed system is 'BAC-net' standard. New controls systems must be compatible with existing installations. Separate software, gateway devices, drivers or routers are not acceptable.
2. Specifications. At the time the School District installed the district-wide system, and revised the previously existing control systems in each of the buildings, Specifications were issued for materials, systems and performance. These specifications are hereby incorporated by reference, and the Architect and mechanical and electrical consultants must use them. Copies may be obtained from the Facilities Department.
3. The temperature control system shall be an extension of the existing DDC system, with pneumatic actuators or Belimo electrical actuators. No electric controls should be used without specific written permission from the Owner. The system shall be placed into operation and adjusted under operating conditions, being carefully coordinated with the related other subcontractors. See section on "Testing, Adjusting and Balancing."
4. Require that the Architect or mechanical consultant deliver a copy of the Temperature Control submittal, including drawings of system layout, connections to central School District system, and detailed sequence of operations, to School

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District Facilities Department for review and written approval prior to release of approved submittal

5. Pneumatic systems are not allowed, except for specialized academic or programmatic needs. All controls shall be DDC.
6. Pump and Boiler Controls:
 - a. DDC system shall automatically control boilers and pumps. The heating pump shall restart automatically after a power failure.
 - b. Rated premium-quality motors are required. VFD's are preferred, and shall be of a Manufacturer approved by Owner. Approved VFD Manufacturers include: ABB, Safetronix, and Siemens.
 - c. The system supply water temperature shall automatically be varied inversely with changes in outside temperature. The schedule shall be adjustable, and shall be controlled by the existing District DDC system.
 - d. Where 2-piping circuits exist, one for unit ventilators, and air handling units and one for radiation equipment, two operating or supply temperatures shall be maintained. Reference outdoor air boiler water reset schedule. Set temperature controls as low as practical for better control operations. When multiple boilers are involved, these several boilers are to be automatically sequenced or staged with the load. Three-way mixing valves shall be used if necessary to maintain proper temperature going out to building
 - e. Systems shall be provided with standby pumps that shall have pump controls and circuits arranged for automatic lead-lag selection of pumps, and alarm circuit on standby pump.
7. Unit ventilators will normally have ASHRAE II control cycle, valve control.
8. Heating and ventilating units will normally have cycle similar to ASHRAE II unit ventilator cycle. Check for exhaust interlocks in kitchens, shops, science rooms etc.
9. Multi-zone and dual duct units shall normally have mixed air and minimum outside air controlled by District DDC system.
10. Provide all unit controls based on the specific use of the area. In general, the simplest controls that will perform the intended function are preferred.
11. Freeze protection shall be provided for all systems handling outside air. Consider the use of face and bypass control for any systems designed for 100% outdoor air (i.e.: make up air units).
12. Outside air dampers shall close any time the fans are off and during warm up of area serviced, per District DDC controls.
13. Provide for night heating by District DDC system, with OSA dampers closed at all times units are in Night-cycle mode.
14. Thermostats - Wall Mounted:
 - a. DDC sensors are used that include adjustable temperature features and override capability (one per zone, mapped for building engineer use and control).

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15. Controls Zones - DDC: The building will minimally be divided into the following dedicated air handling zones for operation. No listed space is to be served by more than 1 unit.
 - a. Auditorium
 - b. Gymnasium, Weight and Locker Rooms
 - c. Administration Area – Multiple zones
 - d. Classrooms to be divided into zones as required by building orientation.
 - e. Media Center
 - f. Music wings or other defined academic areas
 - g. Kitchen
 - h. Cafeteria
 - i. Lobbies, hallways, and common areas.
16. Exhaust Fans:
 - a. Exhaust fans for group toilets shall be controlled with air handlers on District DDC system. Small exhaust fans for individual toilet rooms may be switched on with the lights.
 - b. Kitchen exhaust fans shall have local manual start with hard-wire interlock to makeup air unit.
 - c. Fire Protection: Provide fan shutdown in accordance with latest editions of IBC and NFPA. Where ionization type detectors are used, provide for connection to building fire alarm system or smoke detector in the zone.
 - d. Relief exhaust fans shall be controlled. Fans shall be OFF during night cycle when outdoor air dampers are closed.
17. Entry Heaters:
 - a. Provide 24-volt control circuit
 - b. Provide for DDC control
 - c. Electric heaters are prohibited, except with written permission of Owner

XIV. TESTING, ADJUSTING, AND BALANCING

A. Testing and Start-Up-General.

1. Testing of mechanical systems shall be conducted by the Manufacturer and the Contractor in the presence of a representative of the Architect. The Owner's representative shall also be informed at the start of the tests.
2. Boiler plants and all associated hydronic loops shall be thoroughly flushed to ensure that all construction debris is removed from the system prior to initial operation of the boiler and pumping plant. Flushing shall first be conducted with all terminal valves in a closed position to prevent contamination of coils or other peripheral equipment; then flushed thoroughly with all valves open. Flushing shall continue until little debris is detected at the lowest flush point. Follow Manufacturers specifications for initial fill and operation of the boiler plant.
3. Fill and vent the heating system, add trisodium-chloride boiler cleaning compound and operate system at maximum design conditions (200° F. minimum) with pumps running valves open, and with heating unit fans "off" for a period of 24 hours prior to hydrostatic testing. Pump screens must be in place to divert and capture any remaining construction debris from the system.

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4. Fill and vent the chilled water system with clean tap water. Operate system at maximum design conditions with pumps running and valves open for a period of 24 hours prior to hydrostatic testing. Pump screens must be in place to divert and capture any remaining construction debris from the system. Drain and fill with glycol mixture.
5. Pneumatic control system shall be tested under 50 psi air pressure for 24 consecutive hours during which time the pressure drop shall not exceed 5 psi.
6. Provide for such items as thermometer wells, pressure test cocks, flow meters, access doors, etc., as required to allow tests, adjustments, and balancing to take place.
7. All heating system piping (except compressed air for pneumatic control system) will be tested hydrostatically to 125 psi for at least six consecutive hours during which time the pressure shall remain constant without pumping. Any system components or equipment which cannot withstand test pressure shall be isolated or removed from the system. Welded piping shall be subjected to a "hammer test" and "soap suds" test while under pressure.
8. Test and adjust boiler burner controls.
9. Drain system completely; flush and refill, adding specified boiler water treatment.

B. Boiler System Testing.

1. Provide Factory boiler field combustion tests for maximum and firing rates which include the following information:
 - a. Stack temperature
 - b. Gas pressure and gas cubic feet per hour
 - c. Percent CO₂ and CO
 - d. Presence of CO in flue gas or high stack temperature will require corrective action by the Contractor
 - e. Thermal efficiency
2. Balance and Reports.
The Owner normally chooses to retain the testing and balancing directly. Test and Balance to bid to District. Coordination and scheduling by General Contractor.

XV. MAINTENANCE MANUAL AND GUARANTEE.

- A. Maintenance Manual: Require three typed and 3-ring binder bound copies of a maintenance manual, 8-1/2" x 11" in size, to the mechanical consulting engineer and Architect for their approvals. One copy shall be delivered electronically in Word or PDF format. These approved copies shall then be transmitted to the Owner. The manual shall have, at a minimum:
 1. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operations.
 2. Operating instructions for complete system, including:
 - a. Emergency procedures for fire or failure of major equipment
 - b. Normal starting, operating, and shut down

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- c. Summer shut down
- 3. Maintenance instructions, including:
 - a. Valve tag and other identified equipment lists
 - b. Proper lubricants and lubricating instructions for each piece of equipment
 - c. Necessary cleaning, replacement and/or adjustment schedule
 - d. Complete filter size list and schedule of locations
 - e. Volume of hydronic system in gallons for use in maintaining chemical treatment or percent glycol
- 4. Manufacturer's data on each piece of equipment, including:
 - a. Installation instructions
 - b. Equipment assembly drawings and specifications
 - c. Parts list with recommend replacement stock parts
 - d. Complete wiring and temperature control diagrams
 - e. Marked or changed prints locating all concealed parts and all variations from the original system design. In other words, provided to the Owner a set of "reliable as-built" record drawings
- B. In addition to the maintenance manual, and keyed to it, the equipment shall be identified and tagged as follows:
 - 1. Identify all starters, disconnect switches, and manually operated controls, except integral equipment switches, with permanently applied, legible markers corresponding to operating instructions in the "Maintenance Manual".
 - 2. Tag all manual operating valves with 1-½" diameter brass tags attached with chains. Tags are to be sequence numbered with legible metal stamps. On existing buildings verify with the Department of Facilities the numbering system to be used.
 - 3. Provide a typed tag list or schedule mounted under glass in the Equipment Room stating number, location, and function of each tagged item. Insert a copy of tag list in each "Maintenance Manual."
- C. Contractor shall instruct Owner's representative on the proper operation and maintenance of the system, using the manual as a guide. Boilers, pumps, and refrigeration equipment shall be started up only in the presence of a representative of the Owner. If units are started without the Owner's representative being present, they shall be removed and replaced with a new unit.
- D. Guarantee: The mechanical specifications shall include a notation making clear that all lubrication and changing of filters and other normal maintenance is the responsibility of the Owner, all other servicing of equipment during the oneyear warranty period (from date of substantial completion and Owner acceptance)is the responsibility of the mechanical contractor.

If, in the determination of the Architect or the Owner acting through the Architect, certain items of equipment or components of a system are faulty and need repair or replacement during the warranty period it shall be the responsibility of the Contractor to repair or replace such items at no cost to the Owner.

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DIVISION 16 ELECTRICAL SYSTEMS

I. GENERAL

- A. Electrical Drawing Presentation. For the Owner's use, provide at both the Design Development submittal and the Construction Document submittal separate drawings for the telecommunications/technology equipment plans. These shall be separate from the power plans.
- B. General Requirements. The following represents functional and education requirements that are applicable to the general needs of the school program.
- C. Electrical Design Criteria.

1. General:

Functions and educational requirements as pertaining to electrical systems are described under General Requirements and Room Requirements listed herein. The design engineer shall review these sections carefully to establish intent and scope of educational function for each area.

The following design criteria and recommendations summarize the various engineering aspects of planning, design, installation and maintenance which are to be considered in achieving the following objectives:

- a. Maximum safety.
- b. Performance and reliability.
- c. Cost (amortized, including initial, operating, maintenance, etc.)

These criteria, coupled with specified educational and functional requirements, form the basic guidelines for electrical planning. They are not intended, however, to restrict the design team in the application of other concepts that are consistent with the educational and functional needs and the objectives listed above.

There is a basic need for electric flexibility, especially with regard to space provisions for routing and terminating additional (future) services such as closed circuit and commercial television, computer systems, communications, etc.

2. Protection:

- a. Provide Lightning Protection for building electrical systems
- b. Provide Phase Protection for all 3-Phase equipment
- c. Provide Power Factor Correction to maintain power factors to +/- 95% lagging.

3. The Design Team is responsible for determining requirements for local utility providers including submittal documents, taps, fees and licenses, meters, pressures, etc. The Design Team will determine required meter locations, requirements for separate taps or combined taps, and other specific requirements of all local utility providers for each project.

D. Future Utility Expansion

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1. Consider future additions when sizing utilities. See specific program for project, and consult Facilities Department. A minimum of 25% spare capacity and space shall be provided for future expansion and addition of circuits to all distribution equipment and panel boards.
2. Provide future utilities in location designated by the Facilities Department for future modular buildings, or pods. Specific site requirements for modular facilities shall be reviewed with the Design Team and the Owner' Auxiliary Services Department in the Schematic phase. Provide pedestal for utilities as specified by Owner. Provide a minimum of 2" conduits underground back to appropriate source, i.e., intercom, power distribution, temperature control, Ethernet, etc. Provide separate 1" Fire conduit. Each temporary facility shall be equipped with a comparable level of service as the classrooms within the permanent structure.
3. Include the following:
 - a. Electrical service sized for 1.5 times the total design load of future modular buildings, including future air conditioning.
 - b. Provide a minimum of 25% spare capacity to the clock/bell system, security system, intercom system, fire alarm system, and IT for future expansion. Include the spare capacity for modular buildings or pods.
 - c. The as-built locations of all utilities shall be measured to a $\pm 6"$ accuracy in two (2) directions to the center line of the pipe or box below grade. Measurements shall be taken from building lines, exterior walls, or poured concrete walks. All measurements shall be shown on the as-built drawings. This is a requirement for final payment.
4. Electric Heat and Snow Removal: Snow melting systems or electric heat shall not be used, except by review and written approval of Owner.
5. Code Conformance: Specify and design entire electrical system to be in conformance with latest editions of the International Electrical Code, NFPA 5000, the IBC, Colorado Statutes, Colorado Department of Health, Rules, and regulations governing schools in the State of Colorado and with other State and local jurisdictional requirements.
6. Corrosion Protection: Consider corrosion and water problems with respect to underground conduits. The School District has experienced major problems with corrosion and electrolysis of underground piping. Consider use of rigid plastic (heavy wall), or other acceptable non-metallic raceways for underground conduits.
7. Remote metering: Make provisions for communication from the electric utility metering equipment and the gas service meter to a remote reader. Coordinate with utility and owner for requirements. As a minimum route 3/4" conduit between each meter and the telecommunication closet.
8. IT Requirements: Refer to and maintain as a minimum the current version of district Structured Cabling System Requirements. This document is available from the district IT Department.
9. Motion Sensors: Localized motion sensors should control Lighting systems.

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II. ROOM REQUIREMENTS

- A. Scope. In addition to general requirements listed above, and lighting standards listed under Section IV of this Division, this Section outlines electrical requirements for instructional areas and other specific areas:
- B. It is the designer's responsibility to coordinate the locations of all outlets, switches, devices, etc., with other equipment such as wall cabinets, marker and tack boards, back splashes, gymnasium safety mats, mechanical equipment, etc. Owner will not pay for any relocation of such items if conflict is caused by improper coordination.
- C. General Classrooms and Instructional Areas.
1. Provide three duplex outlets per wall, one mounted in a four-plex box with phone and IP connections in the other ½-plate., except where more are required by specific room layout, make provisions for computers, television, and overhead projector in all teaching areas. Circuit loading for receptacles to permit uses of multi-outlet assembly extensions from most any outlet.
 2. Provide electrical and TV signal distribution outlets high on wall in each classroom, possibly above marker/tack board, toward a "front" corner, for TV monitor. Position monitor to avoid sources of glare. Consult with owner for coordination of TV monitor location. Coordinate with Architect to see that adequate backing exists behind wall for monitor mounting.
 3. Provide computer network and telephone outlets in each room, as described in paragraph 1 above. Refer to the District's Technology Department's most current Structured Cabling System requirements. Avoid placement of network outlets under marker boards.
 4. Floor outlets are discouraged, but when no other alternative is available should utilize flip-up cover locking or waterproof type. Provide carpet flange in carpeted areas.
 5. Provide 3-way light switches near each entrance to instructional areas to facilitate functional use of these areas. Provide occupancy sensor control in all rooms. Light switches to override occupancy sensors.
 6. Provide Owner-specified clock, intercom speaker (also used for program signal) and call-in switch (for remodel projects) for all instructional areas. Refer to the District's Technology Department for requirements for new buildings. Clocks should be located so as to permit maximum visibility from the teaching areas. Coordinate location with room dividers or possible temporary partitions. Intercom Speakers shall be provided to give sound coverage of the individual teaching areas. Locate call-in switch or handset near its respective speaker.
- D. Practical Arts.
1. In addition to the general classroom requirements listed above provide the following for the spaces indicated:

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2. Industrial Arts:
 - a. General illumination utilizing industrial type 4-foot T-8 fluorescent units.
 - b. Provide good receptacle coverage, all walls. Consider plug-in strip at benches. Consider underfloor, flush duct, or overhead plug-in raceway for electrical distribution. Twelve foot maximum spacing in wood and metal shop.
 - c. Provide special outlets as required for shop equipment.
 - d. Provide an emergency power off disconnect method (with pilot light) in each shop to cut off power to all equipment.
3. Technology Laboratory:
 - a. The Technology Laboratory in middle schools and high schools is an emerging program subject to rapid change. Consult with Auxiliary Services Department for current requirements.
 - b. In general, the Tech Lab is a classroom environment modified to include extensive computer stations (frequently grouped) for simulation programs in a variety of technological subjects.
 - e. Illumination should be standard classroom type, appropriate for computer use. Consider 36-cell parabolic lenses or indirect fixtures as a minimum to maintain screen cutoff angles. Dimming ballasts are required, with appropriate manual controls.
 - c. Provide outlets for island-type Tech Lab Computer clusters. There will be 8-10 stations in middle schools and 10-12 stations in high schools, although some stations may be at room periphery. Each station shall be on a separate circuit. Consult with the Owner for elementary standards and applications.
 - d. Provide special outlets as required for specific Tech Lab equipment, with emergency power off disconnect.
4. Life Skills:
 - a. Provide good receptacle coverage on walls, over counters, inside sewing machine cabinets, etc. Special outlet requirements for electric ranges, irons, washer and dryer, dishwasher, etc. Provide GFCI type receptacles where located within 6 feet of sinks.
 - b. Provide an emergency power off disconnect method (with pilot light) in room to cut off power to all heating element type appliances and sewing machines. This disconnect must not turn off lights, refrigerators, freezer circuits, etc.
 - c. Plan BAS circuit for this shutoff purpose.
5. Business Education and Computer Laboratories:
 - a. Provide network and power outlets for computers, (individual receptacles at each desk). Consider feasibility of under-floor duct or overhead raceway for distribution. Provide outlet coverage for all walls, or equivalent. Provide keyed master switch (with pilot light) on cut-off power to convenience outlets. Attention is called to the varying heights of computer and equipment counters required by different grade levels. Consider raceway system for cable management for network cabling.
 - b. Provide computer drop and electrical outlet in ceiling to facilitate installation of ceiling mounted LCD projector. Additionally, provide video connection feed from ceiling location to location within room. Exact location to be determined based on specific needs.

E. Fine Arts.

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In addition to the general classroom requirements listed above provide the following for the spaces indicated:

1. Art Rooms:
General illumination shall utilize approved T-8 full spectrum white fluorescent lamps. Consider full spectrum PL-type spotlights for display area.
 - a. Elementary Schools: Selective switch spots to control intensity of lights.
 - b. Middle and High Schools: Selective switching and rheostat control to dim display spotlights.
 - c. Provide 208 volt, single phase NEMA 6-50R receptacle for 6500 watt kiln and controller. Kiln located in a separate one hour rated room. In addition provide a duplex receptacle adjacent to kiln for "Envirovent."
 - d. Provide outlet strips over counters.
 - e. Provide GFCI outlets in locations adjacent to sinks or serving potter wheels, etc.
 - f. Provide track lighting system for flexibility of spotlight locations.
 - g. Provide computer drop and electrical outlet in ceiling to facilitate installation of ceiling mounted LCD projector. Additionally, provide video connection feed from ceiling location to location within room. Exact location to be determined based on specific needs
2. Music Rooms:
 - a. Outlet requirements for tape recorders, metronome, tape and CD players, overhead projector, movie projector, (rear or middle).
 - b. Provide rough-in for future connection of two high fidelity speakers. Coordinate with owner for exact location.
 - c. Coordinate with Owner for component designs and applications specific to each school's programs.

F. Science.

In addition to the general classroom requirements listed above provide the following:

1. Individual laboratory power supplies (rectifiers) are plugged in at laboratory benches. Provide outlets for electronic test equipment, stirrers, small motors, vacuum pumps, projectors, etc. Consider under floor duct and/or overhead electrical plug-in track, for electrical distribution, for moveable equipment tables.
2. Consider feeding all laboratory outlets, etc., from local panel (in science room) so that unused circuits can be switched off. Selective switching should permit use of some circuits for 24-hour experiments, aquarium pumps, biology refrigerators, etc.
3. Consider conduit for computer network cabling between student stations and instructor's station, in high schools, and middle schools.
4. No placement of data/voice drops within 6ft of sinks or other areas that would pose an unsafe environment to technology equipment and students.

G. Foreign Language.

In addition to the general classroom requirements listed above provide the following:

Provide computer drop and electrical outlet in ceiling to facilitate installation of ceiling mounted LCD projector. Additionally, provide video connection feed from ceiling location

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to location within room. Exact location to be determined based on specific needs. Provide a Bid-Alternate for this installation.

H. Auditoriums.

1. Recessed fluorescent preferred for dimmable house lighting. Fixtures must be easily accessible for lamp replacement without use of scaffolding or lifts. Also provide approved type fluorescent fixtures and lamps for general classroom type lighting.
2. Switch main walk-through lights from most-used entries and from stage. House lights controlled from stage in addition to other points of entry.
3. Provide outlets for cleaning and projector use. Outlet for projector about 40 feet back from stage. Outlet for large-screen television on stage and at face of stage. Outlet for motorized projection screen at stage.
4. Provide a complete sound system. Amplifier to have provision for radio, tapes, compact discs. Consider projector sound through public address speakers. Provide direct line to main intercom console for transmitting programs both ways for distribution to the entire school. Install amplifier in cabinet. Provide three microphone jacks on apron, equally spaced, and provisions for an overhead suspension microphone. Additional requirements as determined by special program.
5. Stage lighting determined by specific program. All dimmers should be specified as low harmonic distortion type.
6. In addition to regular stage lighting, provide fluorescent work lights and normal classroom lighting levels on all stages. Work lights required behind curtain and at sides of stage.
7. All lighting on the stage and auditorium should be controlled from at least one point in the stage area in addition to other control points. Provide locked cabinets for all switchgear or lighting equipment on stage area.
8. Provide outlets in the second stair riser on the front of stage on 8'-0" centers, in elementary schools. Circuits for mechanical and cleaning equipment to be fed from separate panel and not connected to lighting or auditorium panel. Provide outlets for band use. Consider floor pockets on each side of stage for high schools, and middle schools.
9. Provide fire alarm horn at rear of stage with manual station at stage exit.
10. Provide lighting outlets for portable lights at catwalk areas.
11. To accommodate audiovisual equipment, provide floor outlets for 120 volt power and audio cabling for projection of movies in the auditoriums, multipurpose rooms, and other large spaces where wall outlets cannot be used.

I. Gymnasium and Locker Rooms.

1. Gym lighting fixtures should be metal halide type, rigidly constructed, with guards, and Teflon-coated lamps if open fixtures. Design for easy relamping. All lighting to be switched beyond circuit breaker panels, with Owner-specified keyed switches.

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2. Provide scoreboards in middle and high schools, 9" minimum letter size. Verify length of periods required. Wrestling attachment on one scoreboard for high school only. Separate controls when more than one board is used. Mount scoreboards so that bottom is a maximum of 20' above floor receptacles. Control plugs shall be readily accessible-not under bleachers. Provide protection of the scoreboard from gymnasium activities (damage by balls, etc).
3. Large clock, minimum 15" diameter, with guard, size, and location to be visible from maximum area.
4. All cross-court backstops to be motorized fold-up type in middle and high schools, in main gym only. Provide thermal overload protection, limit switches, and momentary contact key switches. Use minimum ½ HP drive motors, one backstop per motor.
5. Provide complete sound system in middle and high school gymnasiums. Provide direct line from main console for transmitting programs both ways and for distribution to entire school. Sound systems for elementary school gymnasiums shall include at least two ceiling speakers or as required, which shall be tied into the main console and intercom system. In addition, these speakers shall be connected so as to permit alternate use with a local amplifier and microphones, or in connections with the sound for movies. Include a microphone jack at: center of platform, each side of platform, and at rear of gymnasium for use with movies. Rough-in for local amplifier which will be furnished by the School District.
6. Provide clock and program (audible) signals in locker rooms.
7. Provide outlets for record, tape and CD players, projectors, recorders, etc. Also, provide at least two outlets for 30 ampere, 120 volt custodial machines.
8. Provide minimum two recessed type convenience outlets (to minimize damage from balls, etc.) per wall in gym, with outlets for each wall fed from a separate circuit.

J. Special Education Classrooms.

In addition to the general classroom requirements listed above provide the following:

1. Lighting should be as for other classrooms, but consider low-intensity part-time lighting for rest periods. Consider use of dimmable sconces in addition to overhead lighting.
2. Provide outlets and wiring to accommodate special needs for these areas, such as washers, dryers, ranges, disposers, etc.
3. Provide separate high-volume exhaust system for lavatories and BAS control to maintain negative pressure for special education rooms.
4. Provide for auto-flush fixtures in lavatories and auto-valve sink fixtures.
5. Provide computer drop and electrical outlet in ceiling to facilitate installation of ceiling mounted LCD projector. Additionally, provide video connection feed from ceiling location to location within room. Exact location to be determined based on specific needs. Provide a Bid-Alternate for this installation.

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K. Administration.

1. General Office – Consult Auxiliary Services and IT for current district standards and specifications for intercom console; telephones and master program control.
2. Secretarial Area - Provide floor outlets or under-floor duct for convenience outlets and communications wiring if desk is not adjacent to a wall.
3. Provide Owner-specified clocks for all offices and faculty workrooms.
4. Provide computer drop and electrical outlet in ceiling to facilitate installation of ceiling mounted LCD projector. Additionally, provide video connection feed from ceiling location to location within room. Exact location to be determined based on specific needs. Provide a Bid-Alternate for this installation.

L. Integrated Media Center (I.M.C.).

1. Provide clocks in the I.M.C. Locate for maximum viewing.
2. Provide intercom station and public address speakers in I.M.C.
3. In resource and student study centers (carrels) provide outlets for tape recorders, viewers, projectors, etc.

M. Miscellaneous.

1. Telephone outlet locations as determined by Auxiliary Services. Generally telephones will be required in all offices. Make provisions for public phones. Coordinate with district's Auxiliary Services department.
2. Verify requirements and locations for vending machine outlets in such areas as student centers, teacher lounges, main lobby, corridors, etc. Provide separate exhaust ventilation for vending area excess heat.
3. Provide separate power on separate circuit to RTU locations for temperature controls and for outlets for power tools, etc., apart from power to RTUs.
4. Call for sound system where required at high school stadiums or athletic fields.
5. Provide separate circuits for vending areas. Provide BAS interface to these circuits to allow control during unoccupied or vacation periods.

N. Security and BAS systems.

1. Provide Emergency Circuit capacity for all BAS and Security systems including CCTV Card Access, and burglar alarms.
2. Emergency Circuit double-duplex outlets high on wall for CCTV recording purposes in Owner-designated CCTV recording location.

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3. Provide for Emergency Circuit and fiber-optic cabling for CCTV use to provide pole-mounted CCTV coverage of all exterior perimeters of building. Coordinate with CCTV and Owner security consultants.

III. BASIC ELECTRICAL MATERIALS AND METHODS

A. General.

1. Wiring Methods, Materials and Equipment: Comply with [ASHRAE Standard 90](#) or most current edition.
2. Identification: All electrical distribution equipment, switchboards, motor control centers, panel boards, transformers, starters, disconnect switches, controllers such as time clocks etc. shall be labeled. Labeling shall include engraved, three layer laminated plastic plate identifying unit served, voltage, horsepower, and where fed from, black with white letters.
3. Conduits:
 - a. Specifications should clearly designate where rigid conduit shall be used and where EMT will be permitted.
 - b. Embedding of conduit in concrete shall be avoided and overhead runs shall be utilized as much as possible. However, when it is unavoidable, conduit embedded in and below slabs on grade may be Schedule 40 PVC with rigid PVC coated ells. Stub-ups shall be PVC coated GRC.
 - c. Compression fittings are preferred for conduits less than 2", set screw fittings are acceptable for larger sizes.
 - d. Conduit fittings shall be of the nylon insulated throat type.
4. Wires and Cables: Minimum wire size shall be #12 except for control or signal wiring. All wire shall be copper with 600V insulation rating of types TW, THHN, THWN, THW. Conductor size #12 AWG shall be solid conductor type. For sizes #10 and above conductors shall be stranded. All motor feeder conductors shall be stranded, including #12 AWG. Refer to code.
5. Splices and Connections:
 - a. Connect No. 6 and larger wire to panels and apparatus with properly sized, solderless, approved lugs or connectors.
 - b. For splices of wire #10 AWG and smaller use insulated spring wire connectors. For splices of wire #8 AWG and larger, use steel split bolt connectors taped to 150% of insulation value with UL listed electrical tape.
 - c. Flashover or insulation value of joints shall equal that of the conductor. Connectors shall be U.L. listed, rated at 600 volts for general use and 1,000 volts for use within fixtures.
 - d. Wire connectors shall be pressure type Buchanan "B-cap" or 3-M "Scotchlok" with nylon insulator, or as approved equal.
6. Supporting Devices: Include the following paragraph in the specifications:
"Where outlets are installed in steel stud type wall systems, provide additional cross bracing, bridging, and/or straps as required to make the outlet completely rigid prior to the application of the wall facing materials."
7. General purpose convenience receptacle outlets shall be specification grade 20 ampere minimum, grounding type with grounding screw. Of same manufacturer as

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other wiring devices. 120-volt circuits shall not feed more than seven (7) duplex convenience outlets per circuit.

8. Call for duplex outlets in a weather-resistant four-plex box with telephone and IP connections. Place at appropriate locations on roof where necessary to service roof-mounted mechanical equipment, as required by latest edition of the International Electrical Code.
9. In new buildings provide 30-amp 2-pole outlet and a 120 volt, 20 amp duplex receptacle for Owner-furnished clothes dryer and clothes washer. Locate outlets in custodial workroom or office, coordinate exact location with Architect and Owner.
10. Provide for cabling raceways in all hallways to support intercom, IT, and other communications needs. Provide a Bid-Alternate for this installation.

B. Wall Switches.

1. Wall Switches: Wall switches shall be as manufactured by General Electric, Hubbell, Pass & Seymour, Leviton, Slater or Eagle.
2. 120/277-volt wall switches shall be specification grade rated 20 amperes and shall be quiet quick make, quick break with toggle handle, and totally enclosed case.
3. Two pole, 3-way and 4-way switches shall be of the same construction.
4. Use key operated switches for lights in all student toilets, gymnasiums, corridors, locker rooms, and other locations where subject to student manipulation, or as directed by Auxiliary Services Department. Use barrel key type operated switches manufactured by Pass & Seymour with locking type mechanism.
5. Switches shall have color-coded bodies using Red for 20-A and Green for 30-A.
6. Switches with pilot light shall be the same as above except that switches shall be equipped with and connected to an integral pilot light.

C. Device Plates.

1. Device plates shall be as manufactured by General Electric, Hubbell, Pass & Seymour, Leviton, Sierra or Eagle.
2. Verify material, finish, and color with Owner prior to specifying.
3. Project specifications must provide for flush device plates to be furnished with vandal proof screws in areas subject to tampering. Contractor to furnish Owner ten(10) vandal proof tools.
4. Install device plates as required for all device boxes and blanked outlet boxes.
5. Device plates shall be marked on the inside with an indelible marker indicating panel and circuit number device is connected to.
6. Exposed conduit in an occupied space, raceway, and plug strips must be coordinated for material, finish, and color with Owner prior to specifying

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D. Motors.

1. Specify clearly that all motors furnished on all Contractor-furnished equipment shall be single phase 120 volt or single phase 208/220 when under ½ H.P. and shall be three phase for ½ H.P. and larger, unless otherwise specifically approved by the Auxiliary Services Department. Use Variable Frequency Drives (VFD) for all motors where appropriate . All motors shall be the 'high efficiency' type and be Energy Star rated.
2. Motors will be furnished under other sections of the work, but shall be wired under this section of the work. Motors shall be sufficient size for the duty performed and shall not exceed their full rated load when the driven equipment is operating as specified capacity under the most severe conditions likely to be encountered. Motors shall be open type, drip-proof, splash proof, totally enclosed, explosion proof or submersible as applicable, with insulation required for the type of motor and for continuous duty based on a 40° C. temperature rise. Motors shall conform to design, construction, and performance requirements of the latest edition of The Rotating Electrical Machinery Standard of the American Standards Association. Call for overload protection at all motors ½ H.P. or larger. Utilize high efficiency motors with minimum efficiency as follows:

1	Motors Minimum Nominal Efficiency		
	Horsepower	TEFC	ODP
	5	89.5	88.5
	7.5	91.0	90.2
	10	91.0	90.2
	15	92.4	90.2
	20	93	91.0

3. Provide phase loss protection for all 3 phase motors.
4. All three-phase motors shall be specifically designed for 480 or 208 volt service, as applicable, to operate satisfactorily on ± 10 percent voltage variations and with an increased service factor. Nameplates shall be placed on the motor by the manufacturer at the factory. Motors shall carry code letters as per Section 430-7 of the National Electrical Code.
5. Line voltage to motors finished and installed by the general, mechanical, and electrical contractors should be connected by the electrical contractor, and control voltage should be connected by the mechanical contractor. See Section 16900, Controls.

E. Starters.

1. All starters, pushbutton stations, and pilot control devices should be of one manufacturer. This requirement is to apply to all equipment furnished by the general contractor, his electrical and mechanical subcontractor. Contractor must submit shop drawings to reflect this requirement.
2. Starters shall be as manufactured by General Electric, Cutler Hammer, Allen-Bradley, Square D, or Furnas.

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3. Controller rated in horsepower with Class 10 overload relay, red pilot light, and toggle operator.
4. Magnetic motor starter shall be NEMA ICS-2, general purpose, Class A, rated in horsepower, 120 volt coil operating voltage with thermal overload pushbutton operator and pilot lights in cover. Thermal overload relays shall be block type with built-in heaters and adjustable dial or dip switch.
5. Variable speed drives manufacturers (VFD) must be ABB, AC Tech, Allen-Bradley, Safetronic, or as approved by Owner.
6. VFD's shall be fully programmable and shall be equipped with manual bypass.

IV. SERVICE AND DISTRIBUTION

A. Service and Distribution.

1. Submit preliminary design study for new electrical service and/or remodeling of existing distribution equipment. Submit recommendations regarding electrical system for an addition to an existing building.
2. Single meter service for lights and power to be used on all new projects.
3. For an addition to an existing building, include statement in specifications to the effect that services to the existing building are not to be disrupted during regular school use. Work shall be scheduled so that service disruption occurs only during school holiday and vacation periods. The Owner shall be advised at least seven (7) days in advance, in writing, of any such disruption.

B. Electric Service.

1. Owner will contract directly with the local utility provider for underground primary feed or any change necessary into transformer at pad or vault. Contractor's work will start at transformer pad or vault on all new construction.
2. Engineer will consult with the local utility provider to determine the most economical and feasible means (if required) of changing existing aerial to underground primary power to the building transformer pad or vault and estimated cost.
3. Route service feeder underground from utility company overhead lines to transformers and service equipment. Provide cable markers to identify route of underground lines. All underground cables to be in waterproof conduits protected from corrosive action by soil. Pad-mounted transformers preferred, or transformers located on poles off school property. If transformer vault is considered, provide first floor or grade location with exterior access. Vault shall be fire-resistive and locked. Use non-flammable liquid-filled transformers.
4. Coordinate and establish ownership of various services with Owner and Utility Companies.

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5. Provide for interconnection of power meter to BAS, including specifications for pulse boards or other gear for signal interface
6. Secondary voltage to be selected on basis of function and economy. Four-wire wye service preferred. Coordinate variations in nominal 277/480 volt, 3-phase, 4-wire wye connected service voltages with specified electrical equipment voltages.

C. Distribution Switchboard.

1. Main Distribution Switchboard. Provide free standing, floor-mounted, breaker-type distribution switchboard. Location to be indicated on the drawings.
2. Install on a 4" concrete platform.
3. Unit shall be completed, fabricated by the manufacturer, shall be of the dead front design, entirely front connected and designed for minimum assembly in the field.
4. Switchboard shall have provisions for the addition of future sections.
5. Interior bussing shall be silver finished copper bus bars throughout. Provide a Bid-Alternate for aluminum.
6. The main cross bus shall be full-sized throughout. Internal cabling will not be permitted. Main and branch switch quantities, frame sizes and number of poles shall be indicated on the drawings.
7. All switches shall be bolted to the bus bars.
8. Switchboard shall be as manufactured by Square D, General Electric, Siemens/TTE, Cutler Hammer, listed by Underwriters' Laboratories. Ground bus shall extend the entire length of switchboard.
9. Coordinate fault protection with short-circuit current available. Consider use of current limiting fuse, combination hi-interrupting capacity fuses with molded case breakers, etc.
10. At the main distribution center provide one 200 ampere and one 400 ampere spare switch or breaker (minimum) for future growth, include additional bussed space at MDC. Design room to allow one additional section of switchgear as a minimum. Size and configure room considering code required exiting issues from the Electrical Room.
11. Provide capacitor bank to maintain Power Factors within building.

D. Safety Switches.

1. Safety switches shall be heavy duty rated quick-make, quick-break, load interrupter knife switch with externally operated handle and enclosure. Switches shall be fused or non-fused as called for on the drawings. The handle shall be capable of locking in the OFF position. The enclosure shall be rated as suitable for the environment in which it is installed. Approved manufacturers shall be General Electric, Cuttler Hammer, Siemens/TTE, or Square D.

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E. Fuses.

1. Fuses, except control circuit fuses, shall be dual element, Fusetron as manufactured by the Bussman Manufacturing Co., or approved equal.
2. The electrical contractor shall furnish and install one complete set of fuses for all fuse holding devices sized in accordance with associated motor and/or conductors to be protected.
3. Specifications should require the Contractor to furnish Owner a minimum of one spare for each size installed, and a cabinet for spare fuses to be located near the Main Distribution Panel.

F. Branch Circuit Panelboards.

1. Provide circuit breaker type panelboards with main breakers where required. Number and size of full-width, thermal magnetic bolted branch circuit breakers shall be indicated on drawings.
2. Panelboards are to be flush-mounted wherever possible. Install panels up to 6 feet 8" ($\pm 2"$) to top of trim.
3. Arrange number of disconnects to reflect maximum economy (including future load requirements) and requirements of the most recent edition of the International Electrical Code.
4. Where panel switching is used, do not feed fans, pumps, heating equipment controls, etc., from the same panel enclosure; i.e., breakers that control equipment which should remain "ON" shall be behind a separate hinged door.
5. Provide panel schedules on drawings (not specifications) showing breakers, sizes, poles, wire size load and feeder sizes.
6. Panelboards shall be circuit breaker Type NLAB or better. Square-D, General Electric, Cutler-Hammer and ITE panels are approved, minimum 20-amp breakers. Breakers and panelboards should be consistent throughout building or addition.
7. Panelboards shall have door-in door type covers and shall be keyed alike. Panelboards are to be constructed of code gauge galvanized steel with factory applied enamel finish. Fronts shall have adjustable trim clamps and directory frames.
8. All panelboards are to have silver finished copper bus bars throughout. Provide separate ground bus in all panelboards.
9. All electrical panel locations shall be shown on the as-built drawings. Include schedule of each panel on drawings.
10. All panelboards and feeders shall be oversized to allow an increase of 30% over connected loads. At least 1/3 of the excess capacity shall be in the form of spare breakers, not just spaces.
11. Two and three pole breakers shall have common trip and single operating handle.

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12. A directory properly identifying each circuit, handwritten in pencil and listing permanent school room numbers, plus the architectural plan numbers, shall be mounted in the directory frame.
 13. Provide one spare 3/4" conduit for every four unused poles in all flush-mounted panelboard--extended from panelboards to an accessible point beyond the area of finish wall or ceiling construction and cap.
 14. Identify panelboards in accordance with identifications on main distribution switchboard.
 15. All other electrical cabinets shall have locking hinged covers. All locks shall be keyed alike.
- G. Where a single disconnecting method is required within the room for Technical Arts, Homemaking, Science Laboratories, etc., to cut off power to equipment, consider the use of a mushroom button located within the room. Provide a pilot light, which is illuminated when the main switch is on. Lighting, heating and ventilating equipment or other horsepower requirements should not be disconnected with this switch.

IV. LIGHTING

- A. Lighting must be consistent with the District's energy-conservation lighting program and standards
- B. Background.
1. The District has completed a District-wide program aimed at reducing energy consumption. The Architect/Consultant will be required to continue the intent of this program in all new buildings, additions and remodeling.
 2. Power consumption for lighting only shall be limited to a maximum of one (1) watt per square foot of gross building area.
 3. Standardization of lamps and ballasts throughout the District has been another aim of this program, and the Architect/Consultant must continue this standardization.
 4. Portions of some Articles herein are taken verbatim from the specifications successfully used in the Program, and should be interpreted by the Architect/Consultant as models, which must be appropriately modified and expanded to suit each specific project.
- C. Suggested Illumination Levels.
1. Note that the illumination levels listed here are below Illuminating Engineering Society recommendations, but are consistent with recommendations of the Colorado Department of Health. These levels have been used successfully in the lighting design done in the School District's recent Lighting Modernization Program. Specific recommended levels at desk height:
 - a. 10 footcandles: Storage Areas, Corridors
 - b. 50 footcandles: Gymnasium elementary and middle school

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- c. 50 footcandles: Kindergartens, General classrooms, Vocational classrooms, Offices, Libraries (IMCs), Music rooms, Special Education classrooms (but see "Controls" Section for special lower-level considerations), Administration including Counseling and Pupil Services, Auditoriums (when used for classroom function, but 10 footcandles for house light level), Teachers workrooms, Staff lounges, lunchroom.
- d. 50-75 footcandles: Art rooms, Science Rooms
- e. 50 footcandles: Kitchens
- f. 50-75 footcandles: High school gymnasiums

D. General Considerations in Lighting.

1. Fixtures in gymnasium and general multi-purpose rooms to be specified with guards and safety chains. Consider re-lamping problems, including access and maintainability.
2. In Industrial arts area, use industrial type T-8 fluorescent fixtures. Where rotating shop equipment is involved, consider use of 4-foot lamps connected to alternate phases to further reduce stroboscopic effect. However, in Industrial Technology areas specify fixture compatible with extensive computer use.
3. Exterior Lighting.
 - a. Provide lighting as required for visibility and security in parking areas, walkways, from parking to building. Avoid scatter light to neighboring areas, control exterior lights by photocell, governed by timer. Review the exterior lighting control with owner during design. Avoid 'light pollution' outside the property lines.
 - b. Protect exterior lights from vandalism by use of vandal proof materials, guards, etc.
 - c. Wall packs are discouraged due to light pollution and CCTV security issues. Preferred lighting is pole- or bollard-mounted and should be designed to compliment security concerns.
 - d. At football field provide H.I.D. lighting with 30 footcandles measured at four feet above the playing surface with a maximum to minimum ratio of 2.5:1. Arrange lights so that any number may be turned on as desired. All wiring to be underground. Mount lights on poles of sufficient height to be higher than 30 degrees above a point 1/3 the distance across the field. Where the football field is also used for soccer the lighting design criteria should be 30 footcandles horizontal, 25 footcandles vertical at 3 feet above the field with a maximum to minimum ratio of 2:1.
 - e. Other exterior site lighting shall be provided as required for safety. Lamps shall be high pressure sodium type unless approved by owner, mounted on 20 to 30 foot metal poles, with cut-off type optics, located away from and aimed toward building. Avoid poles close to buildings which would afford easy access to roofs. Protect fixtures from vandalism. Parking lot lighting is required for all schools. Switch separately from security lighting. Fixtures

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must be adjustable and/or shielded or located to illuminate the parking lot without shining into adjacent residential property.

- f. Avoid exterior bracket lights where they are low enough to be easily vandalized. Soffit lights are encouraged above entryways, but may need protective lenses to prevent vandalism.
 - g. All exterior lighting controls (time of day, etc.) should be coordinated and implemented through the district Building Automation System (BAS). Coordinate with owner.
 - h. Provide for lighting behind exterior CCTV cameras to provide illumination without glare to the camera lens.
4. Interior Lighting:
- a. Corridor lights not on the emergency light circuit shall be controlled by a occupancy sensor. Coordinate sensors with owner and burglar alarm systems. Room sensors may be used for burglar alarm notification in selected areas. Do not install more than one (1) sensor per area for lighting or burglar alarms.
 - b. In special areas such as instrumental music rooms where higher light intensities are required to read sheet music, do not use super high output fixtures which have costly ballasts. Use regular type fluorescent fixtures with high-output electronic ballasts, if necessary.
 - c. Provide emergency and exit illumination in accordance with latest edition of International Building Code. LED exit fixtures are preferred. Provide exit lights at stage (platform), kitchen and all exterior exits. Provide additional emergency lighting in interior classrooms or classrooms without windows or skylights. Provide for separate switching of auditorium emergency illumination.
 - d. Ceiling-mounted exit lights in corridors shall be rigidly mounted, especially in T-grid ceilings, using backing board above ceiling panel, and through-bolting, so that fixture cannot be turned or moved by students. Design a specific detail for this. Provide wire guards on exit lights in gyms, multipurpose rooms and locker rooms.
 - e. Provide gasketed lens type fluorescent fixtures in kitchens, kitchen storage, walk-in coolers, exhaust hoods, locker rooms and shower rooms.
 - f. Provide occupancy sensor control of classroom, office, and general use luminaires for energy conservation on all luminaires except emergency lighting. Occupancy sensors to be by Wattstopper, Mytech, or approved equal. Occupancy sensors shall be coordinated with district BAS and security systems and needs.
 - g. Provide lighting in crawl spaces and at access hatches. Lighting to be fluorescent type with shielding or wire guards.
 - h. Mounting heights and methods should discourage vandalism. Fixtures should not be in locations where students can jump and hang or swing from the fixture.

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E. Luminaire Types.

1. General: The School District has standardized on ballasts and lamps, which must be used.

F. Requirements for Interior Luminaires.

1. General:
 - a. Luminaires shall have manufacturer's standard finish unless otherwise noted. Provide "Damp Location" label where required.
 - b. Recessed or semi-recessed luminaires shall be designed to be compatible with ceiling in which installed. Furnish and install frames where required for proper installation. "Can lights" are discouraged.
 - c. Luminaires requiring caps, mounting spaces, hold-down clips or accessory items shall be furnished complete with same, whether the catalog numbers shown include such items or not.
 - d. Luminaires shall be wired with type A or AA wire. Type AA shall be used where recommended by luminaire manufacturer. Minimum size shall be No. 16. Use larger wire where indicated or where recommended by luminaire manufacturer.
 - e. Fluorescent luminaires shall be connected with flexible metal conduit in accordance with the NEC.
2. Fluorescent Luminaires:
 - a. Luminaires that do not utilize an optical reflector shall have metallic surfaces protected with rust-inhibiting white baked enamel. Reflective surfaces shall have minimum 85 percent reflectance, white enamel, high temperature baked. Provide all wiring channels, internal barriers, socket wiring covers, end caps, reflectors, etc.
 - b. Lens or louvers shall be as called for on schedules. Where acrylic diffusers are specified diffusers shall be virgin acrylic, 0.125 inches thick minimum.
 - c. Doors shall be capable of hinging from either side and gasketed to prevent leakage of light around doorframe edges.

G. Lamps.

1. Acceptable manufacturers: Lamps shall be as manufactured by General Electric, Osram/Sylvania, Philips, or approved other. Provide for low-mercury content legally disposable lamps, including Alto series 80.
2. Incandescent lamps: Do not schedule or specify any incandescent lamps or fixtures, except possibly at Art Room spotlights and stage use.
3. Fluorescent lamps: Shall be high output T8, CRI 85%, 3500K, unless otherwise noted.

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4. High Intensity Discharge lamps:
 - a. All high intensity discharge lamps shall be designed for mounting positions as required by the luminaire in which they are installed.
 - b. Metal halide lamps shall be color corrected.
 - c. High-pressure sodium vapor lamps shall be color corrected.
 - d. Do not specify mercury vapor lamps.
5. Compact (PL) Fluorescent lamps shall be 2700K unless otherwise noted. Use of PL lamps is discouraged due to high replacement cost.
6. For projects of any size, call for contractor to provide one case (30 lamps) of spare four foot fluorescent lamps, one case (10 lamps) of each size of PL lamp, and one case (6 lamps) of each HID lamps. Lamps shall be turned over to Owner at end of project for his stock.

H. Ballasts.

1. Ballasts shall be as manufactured by Motorola, or Owner-approved equal..
2. Fluorescent and Compact Fluorescent Ballasts: Ballasts shall be electronic and CBM certified by ETL. The ballast shall be UL approved and listed Class P. The ballasts shall maintain constant light output through input voltage ranges of plus or minus 25 percent of the line voltage. The ballasts shall be configured so that they will respond to external control signals produced by a photocell or motion detector. To eliminate Radio Frequency Interference (RFI) and Electromagnetic Interference (EMI) the ballast shall not exceed the limitations for Class A (Industrial) applications of the Federal Communications Rules and Regulations, Part 18, Subpart J. The ballast shall include filters to withstand the voltage surge (transients) conditions of IES Publication 587 Category A. The ballast shall be high power factor, minimum of 90%. The ballast shall have a crest factor of 1.7 or lower, and continuously heat lamp filaments as required by ANSI Specification C78.1. The ballast's total harmonic distortion (THD) shall not exceed 20% for the current waveform, and 5% for the voltage waveform, and meet the proposed IES and ANSI specifications for harmonic distortion. The ballast shall be A sound rated. An internal, current-sensitive fuse shall protect the ballast. The ballast's capacitors shall not contain polychlorinated biphenyls (PCB). The ballast's ballast factor shall be 0.925 or greater. All ballast tests shall comply with ANSI C82.2 and IESNA methods.

Ballasts in luminaires selected to operate as emergency luminaires shall operate on direct current (DC) as well as alternating current (AC). Battery backup shall be provided for 1 ½ hour duration.

Where dimming control is necessary, ballast shall provide for the addition of an automatic or manual dimming control connection directly to the ballast, without the need for auxiliary controls or interfaces. The dimming range shall be from 100% to 20%.

3. Utilize master-slave ballasting to maximize number of lamps per ballast.
4. High Intensity Discharge Ballasts:
 - a. Ballasts shall be of the 'Pulse Start', high power factor type. Investigate the use of electronic ballasts for HID use.
 - b. Exterior HID ballasts shall be capable for starting lamps at minus 20° F.

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5. Ballasts shall be integrally mounted in all luminaires unless otherwise noted.
6. Warranties: Ballasts for fluorescent and high intensity discharge luminaires shall be covered by a two (2) year warranty against defects in workmanship and materials. Warranty shall include in-warranty service program for payment of authorized labor charges for placement of inoperative, in-warranty ballasts.

I. Reflectors.

1. Reflectors shall be rigid and non-deforming.
2. Reflector material shall be able to pass an accelerated life test for a simulated period of ten years with no reduction in reflectivity. Manufacturer shall submit, with bid, test results from an independent testing laboratory. Weathering tests shall be performed in accordance with the procedures of ASTM G53. Reflectivity testing after weathering shall be in accordance with the procedures of ASTM E424-71.
3. Reflectors shall be UL listed for the types of installation required on this project.
4. Polished Aluminum Reflectors: Reflectors shall be constructed of "polished" anodized aluminum of .020" minimum thickness exhibited total reflectivity of 88% ($\pm 3\%$) of the visible light spectrum.
5. Specular Silver Film Reflectors: The reflectors shall be a laminate consisting of a light stable polyester optically clear film upon which elemental silver has been deposited, adhered to an aluminum substrate of not less than .025 inches. The reflector assembly shall exhibit a total reflectivity of 95% ($\pm 1\%$) of the visible light spectrum.
6. Warranties: Reflectors shall be covered by a minimum ten (10) year warranty against defects in workmanship and materials. Warranty shall include in-warranty service program for payment of authorized labor charges for replacement of inoperative, in-warranty reflectors.

V. EMERGENCY STANDBY POWER GENERATOR

A. General.

1. Emergency power is required by the State of Colorado under the provisions of local or national codes.
2. The acceptable method of supplying standby power is an engine generator set.
3. Electrical engineer should submit complete Generator Design Analysis.
4. Provide emergency standby power for all schools. Engine type and fuel to be coordinated with available on-site fuel to provide greatest economy and reliability: Natural gas is preferred.
5. Generator set should be fully caged for safety and to prevent vandalism, when located outside.

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6. Generator set should incorporate means to automatically exercise engine on a regular basis.
- B. Emergency standby power source should serve the following type loads, with space capacity for future growth:
 1. Exit lighting
 2. Emergency lighting: where required in corridors, auditoriums, gymnasium, cafeteria, engine generator room, etc.
 3. Fire alarm system.
 4. Civil-defense signals and controls.
 5. Engine-generator derangement signals.
 6. Telephone power.
 7. Intercom power.
 8. Heating water circulation pumps.
 9. Boiler
 10. Building Automation System (BAS) and security equipment circuits.
 11. Server/MDF and IDF closets

VI. COMMUNICATIONS

- A. General.
Refer to the district's Auxiliary Services department for specific requirements.
 1. Lay out, design, specify, or otherwise make provision for, Communications Systems as described below, after consultation with Owner. Communications systems will consist (including some work to be done by others) of the following:
 - a. 16721 Fire Alarm System
 - b. 16723 Security System
 - c. 16726 Automated Temperature Monitoring and Control System
 - d. 16730 Clock and Program System NEED to define clocks
 - e. 16740 Telephone System
 - f. 16750 Computer and Technology System
 - g. 16760 Intercommunication System
 - h. 16770 Public Address System
 - i. 16780 Television Raceway System
- B. Integration of Systems. Because of the proliferation of communications systems within buildings, and in light of recently developed technology, the Architect/Consultant should investigate the possible integration of all or several of these systems, except for Fire alarm which must stand alone. Some possibilities which should be explored might include shared raceways or wire trays, assigned low-voltage communications systems hubs, rooms or closets, accessibility and availability for change of wiring and parts, clustering or integration

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of room outlets or services, etc. Automated Logic is the district BAS vendor, and system integration with AL is preferred.

C. Qualifications of Systems Subcontractors. The following are suggested as minimum qualifications for systems subcontractors doing work under each part of this Section:

1. The systems subcontractor must employ factory-trained technicians and maintain a service organization within 100 miles.
2. The subcontractor must have available as a reasonable optional service; 24 hour call standby.
3. The service organization must be able to respond to a normal emergency call within four (4) working hours.
4. The service organization must maintain all the required spare parts to service any problem within the equipment, on the local office level.

D. Testing and O & M Manuals.

1. The manufacturer's representative shall provide to the owner's representative, documentation of the final testing and verification of system operation and compliance with the specification on acceptance of the system.
2. Operation and Maintenance Manual: Furnish the Owner three (3) Operation and Maintenance Manuals. Manuals shall be bound in standard size, three-ring, loose leaf plastic binder with contents title. Manuals shall include complete catalog cuts, wiring diagrams, operations, and maintenance instructions.

VII. FIRE ALARM SYSTEM

A. Description.

1. Installation of a complete Life Safety System for Fire Control, Evacuation, and Dedicated Emergency Communications. For remodel projects the system shall be zoned per plans, electrically supervised, connected, tested, and left in first class operating condition. For remodels and additions, the panel should be compatible with existing panels. For new buildings the system shall be addressable and networkable. All equipment shall comply with applicable standards of U.L., NFPA, and local authorities having jurisdiction. Conform to the requirements of the Americans with Disabilities Act (ADA) for audible-visual horn-strobe units. Visual indication units shall be provided in all instructional areas and in all room accessible to students and or parents.
2. A building fire command station shall be provided for monitoring the status of the detection and alarm conditions and implementing safe and orderly evacuation of the building occupants during emergency conditions. It shall be located at the main level of access for the responding fire service and shall be readily accessible.
3. Location of the controls, alarm actuating devices, and audible-visual alarm signaling devices shall be shown on the plans.
4. Incorporate any legal requirements for Civil Defense switches or sirens.

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5. Submit all documentation and O&M's both in paper form and electronically in CADD, Word, or PDF formats.
- B. Products.
Furnish the following equipment. Products by Simplex are specified.
- C. Equipment. This may be outmoded.
1. Control Panel: Panel components shall be completely pluggable and solid state. All lamps on control panel shall be visible through door. Panel shall have adequate power supply to power all smoke detectors, horns, and lamps. The Fire Panel must be coded to permanent classroom numbers (not architectural plan numbers), provided by School District. The Fire Alarm Control Panel (FACP) shall contain, but not be limited to, the following components:
 - a. Common Control Module
 - b. 1 set of dry contacts to activate on "alarm", 1 set of dry contacts to activate on "trouble".
 - c. Zone Input Mother Board
 - d. Zone Input Daughter Board
 - e. Relay Module
 - f. Indicating Circuit Module
 - g. Battery Backup
 - h. Enclosure
 2. Annunciation and Initiating Devices:
 - a. Manual Fire Alarm Station: Double action station: A downward pull of the lever shall activate the system. The lever shall remain in the down position until the station is manually reset by a special key. Stations to be semi-flush mounted where shown.
 - b. Ionization Detectors: Ionization type, 24VDC operation, complete, with necessary auxiliary contacts for remote indication or door closer operation.
 - c. Audiovisual Unit: This device shall meet the requirements of the ADA for light output and sound level and provide visual alarm indication as well as audible in a common enclosure. Unit shall have a 24VDC Xenon flasher. Unit shall be constructed of red plastic with the work "FIRE" imprinted in red on the white translucent lens. The audible device shall operate on 24VDC. In some locations visual only indication units shall be permitted when the audible levels are adequate but the visual indication is not.
 - d. Duct Smoke Detectors: Detector shall operate on same voltage and principle as described for ceiling mounted smoke detectors. Detector shall be connected into building fire alarm system on zone as indicated; light a remote indicator lamp to indicate if detector is in alarm.
 - e. Remote Indicator Lamps: For all duct mounted detectors. All remote indicator lamps mount on a single gang box by EC. Install in locations to be visible by building personnel. Lamps to indicate when detector is in the alarm condition. Only one lamp will be required to annunciate an alarm per each mechanical loft. Provide plastic laminate nameplate/s. All such lamps shall be mounted in main FA panel.
 - f. Exterior Horn and Lamp Assembly: Unit shall be approved for weatherproof mounting. Unit shall contain an audible signaling device and a flashing light in a common enclosure.

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- g. Thermal Detectors: Detector shall operate on the rate-of-rise principle. A temperature increase of 15° F. or greater within one minute will cause an alarm.
- h. Fixed Temperature Detectors: Detector shall operate on fixed temperature principle set at 195° F.
- i. Door Closer/Holder: Magnetic door closers supplied by others shall be wired by EC. These shall be 24VDC units. Power and control from fire alarm system.
- j. Remote Graphic Annunciator, Custom: Annunciator shall depict building layout and illuminate zone and zone definition LED lamps. Orient layout with respect to mounting location, easily available to Fire Department.
- k. All wiring shall be shielded type, and shall be in 3/4" conduit.

3. System Operation.

- a. Fire Detection and Control:
 - 1) For remodel projects actuating devices shall be grouped in zones represented by zone Light Emitting Diodes (LED's) on the control panel. For new buildings each initiation device shall have a unique address and be identified at the FACP and remote annunciator.
 - 2) Actuation of a UL approved alarm initiating device shall, at both the fire alarm control panel and remote annunciator:
 - (a) Light the respective red zone alarm LED. This zone LED will remain lit until the actuating device is restored to normal and the system is reset or for addressable systems indicate the address and description of the device in alarm.
 - (b) Cause the respective red zone alarm LED to flash. This LED will continue to flash until the alarm acknowledge switch is actuated. Once acknowledged, the zone LED will be constantly illuminated until the actuating device is restored to normal and the system is reset.
 - (c) Evacuation:
 - i. The audible alarm signals will sound continuously throughout the entire facility. When an alarm condition occurs, a fire alarm evacuation signal shall be transmitted over the horns and the visual signal shall flash until reset. This tone shall be a slow whoop sweeping from 800Hz to 1200 Hz.
 - ii. Should subsequent alarm actuation of a different zone occur, the alarm devices will sound until silenced or the main control panel is reset.
 - iii. The systems shall be capable of automatically transmitting fire information to the Owner Security Office. Dry contacts (normally closed, which open on alarm or trouble conditions) are needed for "alarm" and "trouble" conditions.
 - iv. Alarm lamps shall be provided and located as shown on the plans. These lamps shall be constantly illuminated until the system has been reset.
 - v. There shall be an adequate quantity of zoned auxiliary outputs to provide interfacing to HVAC, smoke dampers, security, and door controls as required per plans and specifications.

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- vi. Each alarm initiating circuit, horn circuit, and battery voltage shall be supervised. Any disarrangement of system wiring such as loss of power, opens or grounds, shall activate the audible and visual trouble indicators. Actuation of the trouble acknowledge switch shall silence the audible trouble indicator, but the trouble LED will remain lit. A subsequent trouble will reactivate the audible trouble indicator. The trouble LED shall be non-cancelling, except by an actual clearing of the trouble condition.
- vii. Power for operating DC smoke detectors and door holders will be obtained from a supervised power supply within the main fire alarm control panel.
- viii. The control unit shall drive its primary operating power from a 120VAC single phase 60Hz supply. There shall also be a 24V battery standby power source capable of operating the entire system for a period to 60 hours in a supervisory mode and then be capable of operating the alarm devices for a minimum of ten minutes. There shall also be a power failure monitor capable of sounding the audible trouble indicator for 48 hours in the event of AC power failure and loss of battery standby.

D. Installation.

- 1. The system shall be installed in accordance with applicable section of NFPA pamphlet #72, and other State and local codes. All final wiring and connections shall be in strict accordance with the manufacturers wiring diagrams. Minimum size for alarm sounding circuit shall be #14 AWG.
- 2. The contractor shall furnish and install in accordance with the manufacturer's instructions, all wiring conduit and the outlet boxes required to complete the system as described herein and as shown on the plans. All wiring shall be in conduit and shall meet national, state, and local electrical codes.
- 3. Wire size minimums shall be specified by the manufacturer and shall be free of defects, shorts, and grounds before connection to the control panel as shown on the shop drawings. Wiring shall be color coded to the District standard throughout as described below.
 - a. Initiating and supervisory circuits:
 - (i) Positive-red
 - (ii) Negative-black
 - b. Indicating circuits:
 - (i) Positive-yellow
 - (ii) Negative-brown
 - c. Door holders:
 - (i) Hot/Positive-blue
 - (ii) Neutral/Negative-white
 - d. Fan controls:
 - (i) Automatic-normal operation-gray
 - (ii) Common- orange

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4. All required outlet boxes shall be shown on the shop drawings and shall indicate size, type, and supplier, and shall be used with no variances except by written approval of the manufacturer and the engineer.
5. Systems connections will be verified by the manufacturer's representative before applying power to the system for final check out.
6. Power for this system shall be taken from the emergency power system.
7. Fire alarm wiring is to be installed in completely separate conduit and outlet system, divorced from any other wiring system.
8. Coordinate voltage of damper motors, fire alarm flow switch, etc., with fire alarm system.
9. Duct detectors shall be located where required by NFPA 90A. MC shall locate and install detectors; EC shall provide all wiring including fire alarm wiring. HVAC shutdown wiring to conform to local codes by MC.

E. Instruction.

1. At a time designated by the Owner, provide instruction to Owner's personnel on operation and maintenance.

VIII. SECURITY SYSTEM

Call for the electrical engineer to provide for all power and conduit needs for integration of security systems. All security equipment including the BAS should be on emergency power circuits. Coordinate development of systems and technologies in coordination with district Auxiliary Services department. Specific interface to the district's existing Automated Logic controls platform is required.

A. BURGLAR ALARMS

1. Provide for the following elements of the School District-wide burglar alarm system, after consultation with the District Auxiliary Services Department.
2. All security system control panels shall be Automated Logic or approved equivalent.
3. Motion sensors in: Main office, computer labs, libraries, hallways, industrial technology rooms and all building entries.
4. Speaker in backbox at building entries.
5. Provision for remote arming of system at entrance(s).
6. Transmission to District-defined central security office.
7. All exterior doorways shall have contactors. New exterior doorways shall have integral sensors.

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8. Wiring shall not be exposed. Provisions must be made to coordinate security wiring with other construction Trades and Schedules.
9. Roof hatches shall have contactors for security purposes.
10. BA systems shall be fully integrated with the facility card access systems described in paragraph C below.

B. CLOSED CIRCUIT TELEVISION (CCTV)

1. Provide for CCTV equipment compatible with the district's existing security equipment.
2. All recording shall be at the local site, and shall be digital.
3. All remote digital recorders shall be accessible via the district's intra-net, with appropriate workstation software and password protections.
4. Exterior cameras shall be fiber-optic connected, with isolation devices as appropriate for lightning protection. Provide separate conduit for fiber-optics as appropriate. Emergency power shall be provided by the electrical contractor in a separate conduit.
5. Position cameras for ease of maintainability. Parapet-mounted cameras should have pivoting retrieval features for rooftop service. Avoid need for lifts for camera maintenance.
6. Use smoked dome to house and protect fixed interior cameras. Consult with Auxiliary services department for dome options and selections.
7. As the Specifier, if the vendor is competitively chosen, require dual technology low-light B&W night vision/color day lighting equipment, with motion sensor activation.
8. PTZ cameras shall have remote control for all associated equipment (via remote site, integrated with operating software).
9. Camera locations and quantity to be coordinated with Auxiliary Services. Specific policies may regulate CCTV use and location. Current district policies and procedures should be obtained by the designers and maintained in design. Coordinate CCTV with district consultant or sole-source vendor, if identified by the district.
10. Provide for digital recording equipment rack and quadra-plex receptacle high on wall directly behind digital video recording rack location. Locate rack in Security offices, or in Front Office administrative area; preferably in interior closet space, above a doorway, or in another non-observable location away from general staff access.
11. Provide power for desk-level video monitor, multi-plexer, and control keyboard for all facilities, located in logical proximity to the recording equipment.
12. Provide power for video monitor inside front desk clerical area (not observable by public) to observe front door activity at all Elementary facilities.
13. Motion-detection by the CCTV system shall be fully integrated to other security systems to provide alarms as appropriate.

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C. CARD ACCESS

1. Provide for all card access systems to be compatible with the district's existing system, including but not limited to: badging, personnel procedures, other equipment, databases, door readers, vendors, manufacturers, service, and interoperability with other systems.
2. Provide for emergency power as required at all doorways associated with card access. Coordinate installed door locations with owner and Architect.
3. Require coordination with Door Hardware provider and Architect for coordination of wired hinges, adequate side jamb space, and coordination of electronic door latch equipment at required locations.
4. Research fire codes specific to each site jurisdiction if electro-magnetic door locking systems are utilized. Passive Infrared (PIR), Request To Exit (REQ), fire alarm interface, and other requirements may apply.
5. All card access shall be fully integrated with the district burglar alarm systems. Valid card presentation after hours shall disarm the BA system. Provide for separate Request-To-Exit card reader device to re-activate system. Integrate with BA digital displays.
6. Provide for rough-in of required conduit and junction boxes for card access readers and electronic latch controls at appropriate wall, jamb or glass locations.
7. Provide card access at accessible playground, special program, and staff parking entry points. Coordinate with owner.
8. Whenever possible, locate card reader inside the vestibule, with card reader glass-mounted at the door.

IX. AUTOMATED TEMPERATURE MONITORING AND CONTROL SYSTEM

- A. See Technical Guide, Division 15, Section 15950, which describe the system and refer to the most current version of: "Falcon School District 49/Building Automation Systems/Specifications (1998)." This work is the responsibility of the Architect's Mechanical Consultant and the Contractor's Mechanical subcontractor, but the Electrical Consultant should be aware of the requirements of this system and coordinate his/her work with the other disciplines involved. Reference is made to 16701 (2), above, "Integration of Systems."

X. CLOCK AND PROGRAM SYSTEM

A. Summary

1. Provide GPS wireless clock system, complete.
2. 120 volt grounded electrical outlet at transmitter tone generator locations.

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B. Definitions

1. GPS: Global positioning System, a worldwide system that employs 24 satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits atomic time, the most accurate and reliable time.

C. System Description

1. GPS wireless clock system shall continually synchronize clocks throughout the facility, and shall be capable of clock readouts in multiple time zones where desired.
2. The system shall synchronize all clocks to each other. The system shall utilize GPS technology to provide atomic time. The system shall not require hard wiring. Clocks shall automatically adjust for Daylight Savings Time.
3. Analog Clocks shall be synchronized to within 10 milliseconds 6 times per day, and the system shall have an internal oscillator that maintains plus or minus one second per day between synchronizations, so that clock accuracy shall not exceed plus or minus 0.2 seconds.
4. The system shall include an internal clock reference so that failure of the GPS signal shall not cause the clocks to fail in indicating time.
5. The system shall incorporate a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.
6. Clock locations shall be as indicated, and clocks shall be fully portable, capable of being relocated at any time.
7. The WT generator system shall provide a tone, a pre-defined times to the public address/intercom system. The tone shall actuate all devices programmed to operate on receipt of the tone.
8. Timing and operation of the WT generator system shall be controlled by software provided by the system manufacturer, housed in the transmitter and programmed by an Owner-furnished PC.
9. The system shall not require wiring from the transmitter to the WT generator.
10. WT Generator: Initially and at scheduled intervals, the WT Generator receives the time data and command packet from the transmitter. Using that information, the WT Generator sends an audio tone to the PA/intercom system.
11. The transmitter shall continuously broadcast (transmit) a time data packet and command packets to the WT generator. The transmitter shall operate on FCC licensed frequencies that have good building penetration and that are regulated by the FCC to minimize interference on the selected channel.

D. Regulatory Requirements:

1. Equipment and components furnished shall be of manufacturers' latest models.

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2. Transmitter and receiver shall comply with Part 90 of FCC rules, as follows:
 - a. This device may not cause harmful interference
 - b. This device must accept interference received, including interference that may cause undesired operation
 - c. Transmitter frequency shall be governed by FCC Part 90.35
 - d. Transmitter output power shall be governed by FCC Part 80.257(b)
3. System shall be installed in compliance with local and state authorities having jurisdiction.

E. Submittals:

1. Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors and finishes of clocks.
2. Operating License: Submit evidence of application for operating license prior to installing equipment. Furnish the license, or if the license has not been received, a copy of the application for the license, to the Owner prior to operating the equipment. When license is received, deliver original license to Owner.
3. Samples: Submit one clock for approval. Approved sample shall be tagged and shall be installed in the work at location directed.
4. Manufacturer's Instructions: Submit complete installation, set-up and maintenance instructions.

F. Substitutions:

1. Proposed substitutions, to be considered, shall be manufactured of equivalent materials that meet or exceed specified requirements of this Section.
2. Proposed substitutions shall be identified not less than 10 days prior to bid date.
3. Other systems requiring wiring and/or conduit between master and clocks, or which require connection of clocks to external electrical power supply will not be acceptable.

G. Quality Assurance:

1. Permits: Obtain operating license for the transmitter from the FCC.
2. Qualifications:
 - a. Manufacturer: Company specializing in manufacturing commercial time systems with a minimum of 10 continuous years of document experience.
 - b. Installer: Company with documented experience in the installation of commercial time systems.

H. Delivery, Storage and handling:

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1. Deliver all components to the site in the manufacturer's original packaging. Packaging shall contain manufacturer's name and address, product identification number, and other related information.
2. Store equipment in finished building, unopened containers until ready for installation.

I. Project Site Conditions:

1. Clocks shall not be installed until painting and other finish work in each room is complete.
2. Coordinate installation of GPS receiver for access to the roof or exterior side wall so that the bracket and related fasteners are watertight.

J. System Startup:

1. At completion of installation and prior to final acceptance, turn on the equipment, ensure that all equipment is operating properly, and that all clocks are functioning. Set all clocks and provide all required programming for the clock system and tone generator.

L. Products:

1. Manufacturer:
 - a. GPS wireless clock system shall be manufactured by Primex Wireless, Inc., N3211 County Road H, Lake Geneva WI 53147. (800) 837-0464. FAX (262) 248-0061. www.primexwireless.com or approved equal.
2. Sequence of Operation:
 - a. Transmitter Operation: When power is first applied to the transmitter, it checks for and displays the soft-ware version, then it checks the position of the switches and stores their position in memory. The transmitter then looks for the GPS time signal. Once the transmitter has received the GPS time, it sets its internal clock to that time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock every time it receives valid time data from the GPS.
 - b. Analog Clock Operation:
 - 1.) When the batteries are inserted into the clock: A.) Press the red button when the red second hand is at the 12:00 position. At this time the microprocessor will lock in the location of the second hand. B.) After the red second hand has passed over the minute hand (first second hash mark after minute hand), press and release the red button. At this time the microprocessor will lock in the location of the minute hand. The microprocessor then assumes the location of the hour hand.
 - 2.) After the red button has been pressed twice, the micro processor will start searching the channels. It will start at channel No. 1 and proceed one by one until it either decodes a valid signal or reaches channel No. 16. If no signal is detected the receiver will be shut off and will try again later. If a signal is received, the microprocessor will store the channel number, set the clock to receive time. For the next minute the clock will beep every time that it receives a valid time signal. If the clock is in a good signal area it will beep once a second. If the clock beeps every few seconds, the clock is in a marginal signal area. Analog

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- clocks can operate in marginal signal areas, but battery life will be about 25 percent shorter.
- 3.) After initial set, the clock will shut off the receiver. On a pre-scheduled basis, the microprocessor will turn the receiver back on and starting with the stored channel, it will again look for a valid time signal. However, the beeper will not operate.
 - 4.) If the clock has not decoded a valid time signal for seven days, then it will go back to a double-step mode. Non-signal reception can be caused by low battery voltage. If this occurs, replace the batteries.
- c. Transmitter Programming: After the transmitter has been set up and is operating correctly, it is programmed to transmit a signal to the WT generator at predetermined intervals. This programming shall be done as part of the contract. A personal computer, having the minimum requirements specified below is required for programming.

M. EQUIPMENT

1. General: The clock system shall include a transmitter, a roof or window mounted GPS receiver, indicating clocks, and all accessories for complete operation.
2. Transmitter: Primex Wireless Model FM-72, consisting of wireless transmitter with GPS receiver. Unit shall obtain current atomic time from satellite. The clock system shall transmit time continuously to all clocks in the system.
 - a. Transmission:
 - 1.) Frequency Range: 72.100 to 72.400MHz
 - 2.) Transmission Range: one mile, open field
 - 3.) Radio technology: narrowband FM
 - 4.) Number of channels: 16
 - 5.) Channel bandwidth: 20kHz maximum
 - 6.) Transition mode: one-way communication
 - 7.) Data rate: 2KBps
 - 8.) Operating range: 0 degrees C. to 70 degrees C.
 - b. Transmitter:
 - 1.) Transmitter output power: +26 to +300dBm
 - 2.) Frequency deviation: +/- 4kHz
 - 3.) Transmitter power requirements: 120 VAC 60 Hz
 - 4.) Internal power requirements: 5 VDC
 - 5.) Carrier frequency stability: +/- 20 ppm
 - c. Transmitter shall have 16 selectable channels to assure interference-free reception.
 - d. Transmitter shall have the following switches:
 - 1.) Time zone adjustment switches for all time zones in the world (including all US time zones; Eastern, Central, Mountain, Pacific, Alaska and Hawaii)
 - 2.) Daylight Savings Time bypass switch
 - 3.) 12-hour or 24-hour display
 - e. Transmitter housing shall be black metal case, 16-3/4 inches by 12 inches by 1-7/8 inches in size.

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- f. Antenna shall be 46 inches high, commercial type, mounted on top center of transmitter housing. Antenna gain shall be < 2.2 dB. Antenna polarizations shall be vertical.
 - g. Transmitter housing shall incorporate a display which shall include the following:
 - 1.) Time readout
 - 2.) AM and PM indicator if 12-hour time display is set
 - 3.) Day and date readout
 - 4.) Indicator for daylight savings or standard time
 - 5.) LED which shall flash red in event of reception problem
 - 6.) GPS reception indicator
 - h. Transmitter shall contain an internal clock such that failure of reception from the GPS will not disable the operation of the clocks.
3. Power Supply
- a. Model Number
 - b. Input: 120 volt AC 50/60 Hz, 0.4 amp.
 - c. Output: 9 volt DC, 1.5 amp
4. GPS Receiver: Model Number Q11695, GPS roof mounted, with 100-foot cable attached.
- a. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, the 3-7/8 inches by 4-3/16 inches by 2 inches, designed for roof or outdoor mounting. Provide mounting bracket for attachment to roof structure.
5. Traditional analog clocks: Wireless analog clocks, 12-1/2 inch diameter for all applications except 16 inch diameter in gymnasium. Analog clocks shall be wall mounted, and 12-1/2 inch diameter clocks shall have polycarbonate frame and polycarbonate lens. Face shall be white. Hour and minute hands shall be black. Analog clocks shall be provided with red sweep second hand.
- a. 12-1/2 inch analog clocks shall be battery-operated, and shall have 5-year battery life.
 - b. Analog clocks shall be capable of automatically adjusting for Daylight Savings Time. An on/off switch located on the transmitter shall disable this function if desired.
 - c. Time shall be automatically updated from the transmitter 6 times per day.
 - d. Analog clocks shall remember the time during changing of batteries.
 - e. 12-1/2 inch analog clock lock: Tamper-proof/theft resistant hangers and slots in the backs of the analog clocks.
 - f. Provide 2 alkaline D-cell batteries which each 12-1/2 or 16-inch analog clock.
 - g. Analog clock receivers shall be as follows:
 - 1.) Receiver sensitivity: >-100dBm
 - 2.) Receiver power: two alkaline D-cells
 - 3.) Antenna type: internal
 - 4.) Antenna gain: -7 dBd
6. Wire Guards: Provide one for each analog clock as follows:
- a. Model No. 14131, 14 by 14 inch size, for nominal 12-1/2 inch diameter analog clocks.
 - b. Model No. 14123, 18 by 18 inch size, for 16 inch diameter analog clocks.

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7. Cable Connection Sealant: Radio Shack Coaxial Cable Connector Sealant 278-1645, or approved electrical grade silicone sealant.

N. EXECUTION

1. Examination
 - a. Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.
 - b. Verify that 120 volt electrical outlet is located within 6 feet of location of transmitter, and that outlet is operational and properly grounded.
 - a. Verify that a compatible PC, meeting requirements specified above, is available for dedicated use during software installation and system testing.
2. Installation
 - a. GPS Unit: Install on roof in location indicated, in clear view of the sky. Install unit in location free from standing water, and above accumulations of leaves or debris. Seal cable connection to GPS with cable connection sealant. Any added cable lengths must be protected from outside elements.
 - b. Transmitter:
 - 1.) Locate transmitter where indicated, a minimum of 2 to 3 feet above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls. The preferred transmitter location for best transmission coverage is centrally located on the top floor of the building.
 - 2.) Attach receiver to transmitter using cable
 - 3.) Connect antenna to transmitter, using care not to strip threads
 - 4.) Connect power supply to the transmitter
 - 5.) Set the channel number on the display to correspond to the FCC license
 - 6.) Plug power supply into electrical outlet
 - c. Analog Clocks: Perform the following operations with each clock:
 - 1.) Install D-cell batteries
 - b. Set clock to correct time in accordance with manufacturer's instructions
 - c. Observe analog clock until valid signals are received and analog clock adjusts itself to correct time
 - d. Install the analog clock on the wall in the indicated location, plumb, level and tight against the wall. If using 12-1/5 inch clock, attach using clock-lock hanging method and suitable fasteners as approved by clock manufacturer.
 - e. Wire guards: Secure to wall, using approved theft-resistant fasteners.
 - f. WT Generator: Install the WT generator in location indicated, and secure to base using fasteners of type recommended by WT generator manufacturer, and suitable for the surface to which it is attached.
3. Adjusting: Prior to final acceptance, inspect each clock, adjust as required, and replace parts which are found defective.

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4. Cleaning: Prior to final acceptance, clean exposed surfaces of clocks, using cleaning methods recommended by clock manufacturer. Remove temporary labels from clock faces. Do not remove labels from backs of clocks.
5. Demonstration: Provide 6 hours of training to Owner's representative on programming the WT Generator, setting and adjusting clocks, replacing batteries and routine maintenance, etc.
6. Protection: Protect finished installation until final acceptance of the project.

XI. TELEPHONE RACEWAY SYSTEM

A. General.

1. Refer to the District's Auxiliary Services Facilities and Technology Departments. Voice over IP required.
2. Work Included: Call for the Electrical Contractor provide all telephone raceways, outlet boxes, blank device plates, and terminal cabinets, and show locations on the drawings. Consult with the telephone company, and comply with their requirements and local codes.
3. Verify requirement with local Fire Department regarding extension of telephone conduit for emergency service at a specified location at front of building or to a fire alarm box.

B. Installation.

1. Conduit runs of less than 100 feet from point-to-point shall not contain more than two 90°, 24" radius bends. Conduit runs exceeding 100 feet from point-to-point or exceeding two 90° bends shall contain accessible pull boxes. Conduit runs shall not contain oval or square fittings. All feed conduits to telephone terminals shall enter top or bottom on extreme right or left side. Provide plastic pulling string in all raceways over 50 feet. Provide blank covers for all boxes.
2. Design and provide rooms for the Main Distribution Frame "MDF" and the intermediate distribution frame "IDF" to service both the telephone and computer hub needs. Coordinate with the District's "Technology Plan."

XV. COMPUTER AND TECHNOLOGY SYSTEMS

A. Background.

1. Refer to the District's Auxiliary Services Facilities and Technology Departments . The Owner is expanding, a part of the current building program, various aspects of its computer technology system and equipment.

B. Scope of Intended Work.

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1. The Architect may be required to provide for conduit, raceways, wireways or boxes for cabling and equipment to be provided by others under separate contracts. Such cabling or equipment may include replacement of existing Local Area Network equipment with updated technology.

XVI. INTERCOMMUNICATION SYSTEM

A. Scope.

1. Coordinate requirements with the District's Auxiliary Services Facilities and Technology Departments Show and specify a complete electronic communication and sound distribution system.
2. In general, this system shall provide emergency announcement, two-way intercommunication, provisions for background music, and distribute class change signals throughout the facility.

B. Equipment.

1. Consult with the owner for equipment to be specified.
2. The system shall feature function identified, color keyed illuminated pushbuttons with associated color guidelines. Step by step operating instructions shall be printed directly on the front panels of the control units.

The system shall consist of the following: A sound and communications center (equipment rack), classroom speakers, other remote speakers, call-in switches, and all associated material, hardware, and wiring necessary for a completely installed and operating system which meets the specified requirements.

Ease of operation by the average user should be a prime consideration.

The Sound and Communications Center should incorporate one program channel and one intercom channel, and should be manufactured, assembled and tested by the factory.

3. The Channel A Master Control Panel shall feature functions identified, color keyed, illuminated pushbutton switches with associated color guidelines. Emergency and normal operating procedures shall be permanently printed on the front panel. The panel shall be solid state and shall provide a built in microphone, all-rooms and selected-rooms program transmit pushbuttons, remote emergency telephone facility, output level indicators, and automatic output level control.

The panel shall contain the following:

- | | |
|-------------------------|--|
| a. Preset Control: | Bass and treble tone (boost and cut)
Channel output level
3 microphones
4 auxiliary
External all call adjust
Level indicator adjust |
| b. Front Panel Control: | 3 microphone selectors
4 auxiliary selectors
Monitor speaker level |

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2 program transmit pushbuttons
Emergency pushbutton

4. The Communications Control Panel shall feature function identified, color keyed, illuminating pushbuttons with associated color guidelines. Operating procedures shall be permanently printed on the front panel. The panel shall be solid state providing automatic level control. The panel shall provide automatic supervisory and call in tones. The panel shall contain the following:
 - a. Preset Control:
 - Panel level (incoming)
 - Room level (outgoing)
 - VOR sensitivity
 - b. Front Panel Control:
 - Push-to-talk pushbutton
5. AM/FM Tuner/Tape and compact disc player. The tuner shall be completely solid state, with full-range tuning.

The front panel control shall include a tuning control, AM/FM switch, tone control, balance control, ON/OFF volume control, and an FM stereo indicator light.

The cassette tape player shall play standard 1-7/8 IPS stereo cassettes. Frequency response shall be 50 to 8000 Hz with less than 0.3 WRMS wow and flutter. Compact disc player shall be a single disc type.

The power amplifier shall be completely solid state, and shall be capable of delivering sufficient output for the building, with 25% reserve, with less than 3% distortion from 40 to 10,000 Hz. Balanced or single ended 25 or 70V shall be within 2dB from no load to full load.

The amplifier shall have protective circuits, including a thermally operated relay and an automatically resetting electronic circuit, to reduce dissipation under overload or short circuit conditions.
6. The power supply shall furnish 24VDC. The supply shall operate on 105 to 125VAC by use of primary transformer taps. The input shall be protected by an electronics fold back circuit and a resettable circuit breaker. The fold back circuit shall be self restoring when the overload or short circuit condition is removed.
7. The equipment should be mounted in a wall-mounted or vertical cold rolled steel rack, welded and bonded to form a solid assembly. Bolted construction not acceptable.
8. The intercom console shall consist of, but not be limited to the following:
 - 1 Rack enclosure
 - 1 Channel "A" master control
 - 1 Communications control
 - 1 Power supply
 - 2 Speaker select panels
 - 2 Time cross connect kits
 - x Time control relays
 - 1 Time program chassis
 - x Time program chassis relays
 - 1 AM/FM cassette/CD player
 - 2 100W power amplifiers

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- 1 Tone generator
- 1 Annunciator power supply
- 1 Desk microphone

Allow for calls, announcements, and emergency announcement to be accomplished from handset, desktop, master, or selected stations throughout the school rather than just from the microphone at the central rack.

- 9. Remote intercom field equipment shall consist of, but not be limited to, the following:
 - x - Call-in switches
 - x - Time-tone enclosures
 - x - Hallway speakers
 - x - Backboxes and grilles for gym speakers
- 10. AM/FM Antenna. Call for roof-mounted antenna with necessary mast mounting, guy wires, transformers, lighting arrestors, etc. If possible to piggyback the FM signal off the cable TV system, consider eliminating the rooftop antenna.
- 11. All intercom wiring shall be shielded type, and shall be run in minimum 3/4" conduit.

C. Operation and Performance Requirements.

- 1. The system shall provide, as a minimum, the following functions:
 - a. Emergency announcements: At a preset volume level, to all system speakers, regardless of speaker selector switch positions, by the operation of a single, press-to-talk switch and by the use of built in control panel microphone. The switch shall be located on the Channel A Master Control Panel and be color coded (red) with emergency announcement instructions clearly labeled immediately above the switch. The switch shall illuminate when pressed. The emergency operation shall bypass all other control functions and override all other programs.
 - b. All Call Capability: Transmission of a voice announcement to all classrooms and other speaker locations by the operation of a single switch. The all call switch shall be labeled ALL ROOMS and shall illuminate when pressed.
 - c. Intercom Capability
 - 1) Provide simultaneous use of 100W program channel and an intercom channel.
 - 2) Provide annunciator call-in tone.
 - 3) Adequate power to override high noise level areas such as shops, music rooms, gyms, etc., permitting practical 2-way voice communications.
 - 4) Automatic volume level, one for talk, and one for listen, to maintain a constant, predetermined sound level on all conversations.
 - 5) Supervisory tone: Facilities for automatically sounding a supervisory, warning tone signal (beep) over any speaker selected by the central control or an administrative control center, to alert personnel in the room to the call and to prevent unauthorized monitoring (eavesdropping). The warning tone shall repeat at regular intervals.
 - d. Program Capability
 - 1) Separate inputs and preset volume controls for three microphones with preamplifiers and for four auxiliary program sources. Select program sources as follows:

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- (a) Reception of either AM/FM radio broadcasts or reproduction of recorded music and other program material from built in tuner/cassette/CD player, and their distribution to any and all speakers.
 - (b) Distribution of programs originating at remotely located microphones, with provisions for volume control at the remote location.
- 2) Program source selection shall be accomplished by pressing the appropriately labeled color coded pushbutton switch.
 - 3) Built in control center microphone, with external microphone required.
 - 4) Distribution of voice announcements from the control center microphone to any or all speakers.
 - 5) Selective distribution of program material to any or all classrooms or other speaker locations. One program channel shall be provided.
 - 6) Selective distribution of all program material to other speaker locations with adequate reserve panel space for expansion.
 - 7) Automatic volume level on all program material shall be maintained at a predetermined level by means of built-in compressor.
 - 8) Preset bass and treble controls (boost and cut).
 - 9) Permit monitoring of all program material before distribution to the selected speakers.
 - 10) Provide dedicated intercom switch for isolated program distribution to the gymnasium, hallway, and exterior speakers.

D. Installation.

- 1. All sound system wiring shall be in conduit.
- 2. All horns shall be furnished complete with appropriate mounting hardware to suit installation.
- 3. Coordinate gypboard "tents" for speakers in all fire rate ceiling locations as required.
- 4. Classroom selection shall be arranged sequentially by permanent classroom numbers (not architectural plan numbers), provided by School District.

E. Instruction.

- 1. At a time designated by the Owner, provide instruction to Owner's personnel on operations and maintenance.

XVII. PUBLIC ADDRESS SYSTEM

- A. Scope. Refer to the District's Auxiliary Services Facilities and Technology Departments. Show and specify a complete voice reinforcing system in the Gym/Multipurpose room and/or the Cafetorium. The following specific equipment listed is intended only as a guide to equipment which has been satisfactorily used in the past, and is not mandatory.

B. Equipment.

- 1. System components shall consist essentially of a recessed, locked amplifier, with one octave equalizer with microphone compressor, ceiling speakers, microphone, and microphone receptacles.

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- a. Mixer amplifier: TOA #W906, with (4) H31-S microphone inputs (rear), and
- b. E01 input (front)
- c. Microphones: 2 each: AKG D190E with Switchcraft 13M connectors
- d. Floor Stands: 2 each: Atlas MS-20
- e. Gym and Cafeteria Speakers: Consider sound sphere type speakers
- f. Grilles: Soundolier 51-8
- g. Backbox: Soundolier Q408
- h. Lift Jax: Switchcraft SF Series (school to supply portable amp)
- i. Microphone Outlets: Switchcraft G3FS

C. Operation and Performance.

- 1. System is to provide:
 - a. Sound reinforcement into the Gym/Multipurpose room from either "live" performance, or prerecorded material, such as tapes and compact discs.
 - b. Switches are to be provided on the front panel of the amplifier to allow certain speakers to be turned on or off.
 - c. A speaker location and switching diagram engraved in plastic laminate is to be fastened permanently to the front door of the amplifier.
 - d. Provide for 4 microphone inputs, 1 compact disc player input, and 1 tape player input.
 - e. The gym PA system shall also accept input from the school intercom system. The ceiling speakers shall be common to the gym PA system and the school intercom system. Automatic switching shall enable emergency announcements on the school intercom system to override the program on the gym PA system.

D. Installation.

- 1. All sound system wiring shall be in conduit.
- 2. Mount amplifier about five feet up; height may be adjusted to course out the in masonry walls.
- 3. Coordinate gypboard "tents".

E. Instruction.

- 1. At a time designated by the Owner, provide instruction to Owner's personnel on operation and maintenance.

XVIII. TELEVISION SYSTEM

- A. Scope. Refer to the District's Auxiliary Services Facilities and Technology Departments. In general this system shall provide raceways for future television system, unless consultation with Owner indicates that a full television cabling system is required, or unless it is determined that this system be integrated with other communications systems.

B. Equipment.

- 1. Cable television company will furnish outside signal cable to main TV distribution panel or box. Architect to call for provision of cabling, splitters, amplifiers, outlet boxes, outlet covers, etc., for distribution beyond the panel, as well as VCR tape

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signal distribution system. Consult with Facilities Department on possibility of CCTV capability.

2. Use of a satellite dish is to be anticipated. The District will supply and wire the dish, however, rough-in of conduit and any power requirements must be provided. Coordinate with District for location and size of conduit or power required.

XIX. CONTROLS

A. Motion Detectors

1. The occupancy sensors shall be capable of detecting presence in the floor area to be controlled by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
2. Upon entering a space, motion from both technologies must be sensed before lighting will be turned on. After this has occurred, detection in either technology will hold lighting on for the set period. Sensors will have a retrigger time delay where only one motion is necessary to turn on the lights within 5 seconds after turning off.
3. Ultrasonic sensors must be volumetric in coverage. Up to 10 difference passive infrared patterns must be available by lens selection. Detection shall be maintained when a person of average size and weight moves only with or a maximum distance of twelve inches either in a horizontal or vertical manner at the approximate speed of 12 inches per second. The sum of this distance, volume and speed represents the average condition an occupancy sensor must meet in order that the lights will not go off when a person is reading or writing while seated at a desk.
4. Sensors will cover a minimum of 1,500 square feet when mounted at 12 feet.
5. The sensors are designed to be wall or ceiling mounted and should blend in aesthetically with the space.
6. Each sensing technology shall have independent sensitivity adjustments and LED display.
7. Sensitivity adjustments shall range from off a "0" to maximum at "10" for each technology.
8. Time delay range shall be adjustable from 15 seconds to 15 minutes.
9. Sensors shall operate on 24 volts DC power, power draw is 25 milliamps.
10. Sensor shall have an additional isolated relay with normally open, normally closed and common outputs for use with HVAC control, data logging, and other control options.
11. Sensor shall have an adjustable internal photo sensor with a 24 VDC output after occupancy and a minimum light level is obtained. Adjustable from 5 to 400 footcandles.

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12. Ultrasonic circuit shall be solid state, controlled with advanced signal processing and crystal accuracy.
 13. Ultrasonic receivers shall be temperature and humidity resistant with less than a 6dB shift in the humidity range of 10% to 90% and less than a 6dB shift in the temperature range of -20C to 60C.
 14. Power supply shall be provided by UL listed power pack that consists of a transformer and contact closure relay in one package. Power output of the transformer shall be 100 ma, 24V DC, and shall be capable of operating a minimum of two dual sensors.
- B. Manual Dimming Switches
1. Dimming switch must be compatible with ballast.
 2. A separate on and off illuminated switch shall be provided on device.
 3. Preset light level setting shall be provided on device.
 4. Device shall fit in a single-gang wall box.
 5. Device shall operate ballast on a 0.5 to 10 V DC signal.
 6. Device shall be available for 120 or 277 VAC.
 7. Device shall be UL listed.
- C. Review classroom switching scheme with owner.
- D. Time Switches and Photocells
1. Use Tork T932L, Surface, where time switches and photocells are required. Use Asco #91732071-277-60HZ-C contactors where applicable.
- D. Interface between Mechanical and Electrical Equipment.
1. The following schedule is suggested for the division of Mechanical and Electrical subcontractor responsibilities. Architect is free to change it to suit specific project conditions. It is suggested that the identical schedule appear in both the Mechanical and Electrical divisions of the specifications:

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A. HVAC Equipment Schedule

	Furnished By	Set By	Power Wiring	Control Wiring
Equipment Motors	MC	MC	EC	--
Motor Starter & Overload Heaters	MC	EC	EC	MC
Fused & Unfused Disconnect Switches, Thermal Overload and Heaters	EC	EC	EC	--
Manual Operating & Speed Switches	MC	EC	EC	EC
Control Relays & Transformers	MC	MC	EC	MC
Line Voltage Thermostats & Time Switches	MC	MC	EC	MC
Low Voltage Thermostats	MC	MC	MC	MC
Temperature Control Panel	MC	MC	EC	MC
Motor & Solenoid Valves, Damper Motor, PE & EP Switches	MC	MC	--	MC
Pushbutton Station & Pilot Lights	MC	MC	--	MC
Temporary Heating Connections	MC	MC	EC	MC
Refrigeration Cycle Controls	MC	MC	EC	MC
Duct Mounted Fire Detectors	MC	MC	EC	MC/EC

MC = Mechanical Contractor

EC = Electrical Contractor

* Motor interlock by MC - Fire alarm system interconnection by EC

2. HVAC Equipment Installation
 - a. All starters furnished by MC, and shall be complete with three OL heaters and conform to NEC and NEMA requirements.
 - b. Provide rain-tight switches for units on roofs. Switches shall conform to requirements as specified elsewhere in specifications.
 - c. Control relays and transformers furnished by MC except where electrical specifications and/or drawings state otherwise.
 - d. EC shall refer to mechanical specifications and plans for power and control wiring and advise Architect of discrepancies prior to bidding. EC shall be responsible for wiring as outlined whether on mechanical or electrical drawings and specifications. No extras allowed for contractor's failure to provide for items on mechanical drawings or specifications.
 - e. Exhaust fans: Furnish and install circuits, feeders, disconnect switches, and make all connections to motors and controls. Furnish two-pole switches where controlled in combination with lighting.
 - f. Provide one duplex receptacle (WP) adjacent to roof-mounted equipment, within 50' radius. Provide conduit and wire to nearest available 120V circuit as required.

E. Motors.

1. All motors furnished under Division 16 shall be single phase, 120V when less than ½ HP and shall be 240/480V three phase for ½ HP and larger, unless specifically noted otherwise.

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XIX. COMPLETION, TESTS, INSTRUCTIONS

A. Completion.

1. Clean all electrical equipment and accessories.
2. Test all systems and place in proper work order prior to demonstrating systems to Owner.
3. Perform tests required by authorities having jurisdiction.
4. Instruct Owner's representative(s), on the proper operation and maintenance of the electrical systems.

B. Operating and Acceptance Tests.

1. After the installation is completed, the following operating and acceptance tests shall be performed in the presence of the Owner's representative, who shall observe the testing procedure. This observer shall witness the test readings and procedures and so indicate on the test report. The Contractor shall prepare a brief test report indicating the values of all test readings, where measured, together with any other pertinent information. He shall send three (3) copies of the test report to the Architect/Engineer and if acceptable the Architect/Engineer will forward two (2) signed copies to the Falcon 49 School District Facilities Department.
2. The Contractor shall arrange for and furnish all equipment, instruments and personnel required for the operating and acceptance tests outlined below.
 - a. With all equipment and lighting turned on (insofar as is practicable) take load measurements at the main service and for all feeders leaving the main distribution panelboard and record these phase by phase.
 - b. Perform an insulation resistance test on all feeders leaving the main distribution switchboard. All readings shall be within the requirements as recommended by NEC.
 - c. Perform an insulation resistance test on all phase bussing within the main switchboard with the service disconnected, with all fuses in place, the mains closed, and all outgoing feeder switches open. A 500 volt meter shall be used for this test.
 - d. The service ground shall be tested to demonstrate that the resistance to ground does not exceed 5 to 10 ohms recommended; NEC maximum is 25 ohms.
 - e. Load balance test the distribution system. Unbalance between phases shall not exceed 10 percent with full lighting and mechanical loads. Correct any unbalanced load conditions exceeding this limit. Corrections shall be indicated on record drawings.
 - f. Conduct a careful visual inspection of switchboard bus structure and cable connections to insure that factory and field connections are tight. Special attention shall be given to all bus and cable connections, which must be electrically and mechanically secure.

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- g. Include such other acceptance or operating tests as recommended by the electrical design engineer for various systems involved.
- h. Include in specifications a requirement that the Contractor notify the Architect and Owner when electrical testing is scheduled.

3. Operating and Maintenance Manuals.

- a. Make up the operating and maintenance manuals as specified and submit no later than two (2) weeks prior to the completion of the project.
- b. Equipment described in manuals shall include the following:
 - 1. Electrical Distribution Equipment
 - a. Switchboard, panelboards
 - b. Safety switches
 - c. Transformers
 - d. Contactors
 - e. Circuit breakers
 - f. Fuses
 - g. Wiring devices
 - 2. Lighting
 - a. Lamps
 - b. Ballasts
 - c. Luminaires
 - d. Dimmers
 - e. Time Controls
 - f. Low Voltage Controls
 - 3. Communication Systems
 - a. Intercom
 - b. Public address
 - c. Master-slave clock and program
 - d. Fire alarm
 - e. Security
 - 4. All other electrical systems which require periodic cleaning, adjustment, service, or maintenance.
- c. Information contained in the operation and maintenance manuals shall consist of catalog data on each item, together with parts lists, wiring diagrams, description of routine maintenance required, suggested frequency of maintenance and recommended replacement parts operation, and maintenance manuals shall be 8-1/2" x 11" size.
- d. Submit one copy of the manual to the Engineer for review prior to preparation of final copies. After review, make changes as noted and prepare three (3) final copies of manual to be turned over to the Owner and Engineer.

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- e. This contract will not be considered completed nor will final payment be made until all specified material, including test reports, is received in this operating and maintenance report and the manual is approved by the Engineer.

<<<<END OF DIVISION 16>>>>

Falcon School District 49
Technical Guide for New Construction
Including Additions and Remodeling

APPENDIX -- NOTES and MEMOS

Technical Guide -- Notes and Memos

1. Incorporate Master Format subsections where appropriate –
 - a. Temperature Controls section
 - b. Cut and paste as needed to move existing sections as required
 - c. Re-name or otherwise include Master references if needed
2. Attachments:
 - a. Controls Standards – what controlled, operating seq.
 - b. Lighting Specifications – footcandles, fixture types, lamps
 - c. Mechanical Design Standards – size, design standards, SEER
3. Definitions:
 - a. Terms
 - b. Abbreviations
 - c. Standards and Regulatory Entities
4. Technologies
 - a. Condensing boilers
 - b. Chillers versus DX cooling/zoning
 - i. Water towers/drainless
 - c. Separate zones for media centers, conference, office
 - d. No HID interior except Gym (Cafeteria?)
 - e. Security section
 - i. Burglar Alarms
 - ii. Card Access
 - iii. CCTV
 - f. Motion sensors for lighting
 - g. Controls section
 - i. Connect directly to Automated Logic
 - ii. No substitutions!
 - iii. Programming sequences – energy
 - iv. Submittals, graphics, documentation
 - h. Alternate resources:
 - i. Ground-source heat pumps
 - ii. Wind
 - iii. Photovoltaic
 - iv. Wells
 - i. Water conservation:
 - i. Meters
 - ii. Artificial surfaces
 - iii. Limited grass areas – natural plantings/drought-resistant