MECHANICAL DESIGN CRITERIA
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MECHANICAL DESIGN CRITERIA

I. GENERAL

A. The Design Professional shall use this document in conjunction with the District Master Specifications (DMS) to develop the design and contract documents.

B. The Design Professional is encouraged to specify and select high efficiency equipment and systems, as well as peak demand shifting and energy storage systems that can qualify for energy rebate incentive programs offered by Florida Power & Light Company (FPL).

   1. Exercise caution to maintain competitive bidding and avoid single-source supply of such equipment and systems.

C. Goals:

   1. Design the project to meet a nationally recognized high-performance green building rating system as approved by the Department of Management services. Such approved systems include the:
      a. United States Green Building Council, Leadership in Energy and Environmental Design (LEED).
      b. Green Building Initiative’s Green Globes rating system.
      c. Florida Green Building Coalition Standards.
      d. International Green Construction Code.
   2. Design HVAC systems to create safe and comfortable environmental indoor conditions conducive to learning.
   3. HVAC systems must control and maintain indoor temperatures, humidity levels, CO2 levels, provide required outdoor ventilation rates and not exceed noise levels as specified in this document or as required by applicable codes, standards, and regulations.
      a. Indoor air must be clean and odor free.
   4. Design HVAC systems and building envelope to maintain positive building pressurization and eliminate infiltration of unconditioned humid air to the building interior.
      a. This will prevent Indoor Air Quality (IAQ) or sick building syndrome problems manifested by the intrusion of moisture and/or presence of mold, mildew, and musty smells.
   5. Design the HVAC systems and building envelope to meet applicable Energy Efficiency Code requirements.
   6. Design of HVAC systems must be coordinated with the architect to be accessible and compatible with all components of the life safety systems.
   7. Design of the HVAC systems must comply with the standard noise criteria for classrooms and municipal codes for property located adjacent to the campus.

D. This division contains requirements for the following sections:

   1. HVAC Design Criteria

E. In this document, the term “Engineer” represents the professionally qualified Design Engineer of Record and/or Engineering Consultant, duly licensed in the State of Florida, that signs and seals project design documents.

F. The Engineer is the person “responsible in charge” for the design and development of all project documents.

G. Project documents shall conform to and incorporate all requirements included in this document (Mechanical Design Criteria) and in Permit Documentation Requirements listed in guideline BD-001.

H. The Engineer must request, in advance and in writing, the approval for deviations from the requirements in Mechanical Design Criteria and in Permit Documentation Requirements.
   1. The SDPBC shall review the requested deviations, and based on good engineering practices and/or economics, either approve or deny the request in writing.
   2. Any approved deviations are valid only for the specific request and for the specific project.
I. Project documents shall be in compliance with the following code requirements as adopted, updated and in effect on permit application date:
   1. Florida Building Code, FBC
   2. Florida Building Code, Energy Conservation
   3. National Fire Protection Association, NFPA
      a. Florida Administrative Code, specifically FAC Chapter 69A-58 "Fire Safety in Educational Facilities", and FAC Chapter 69A-60 "Florida Fire Prevention Code"
   4. American Society of Heating Refrigerating and Air Conditioning Engineers, ASHRAE standards
   5. Selected green building rating system
J. Submittal requirements as listed in guideline BD-001 – Submission for Project Documents
K. Section "I" provides Index of Abbreviations and Acronyms that may not be spelled out in the text of this document.

II. CRITERIA

A. HVAC DESIGN - GENERAL
   1. Design Documents
      a. The project shall comply with all codes and the requirements of this section.
   2. Site Plan and Building Plans:
      a. For requirements, refer to guideline BD-001, Permit Documentation Requirements, Phase III – Complete Building Permit, HVAC Requirements.
   3. Building Envelope:
      a. Provide permanent vapor barriers that prevent air infiltration and vapor transmission through the walls and the roof/ceiling assembly, and that maintains their integrity for the life of the building.
      b. The proper location of the vapor barrier in humid climates is on the exterior.
      c. DO NOT use batt insulation on top of a lay-in ceiling with a ventilated attic.
      d. Coordinate with Architect.
   4. Floor Plans and Sections:
      a. For requirements, refer to guideline BD-001, Permit Documentation Requirements, Phase-III – Complete Building Permit, HVAC Requirements.
   5. Roof Plans:
      a. For requirements, refer to guideline BD-001, Permit Documentation Requirements, Phase III – Complete Building Permit, HVAC Requirements.
   6. Energy Rebates
      a. For schools served by Florida Power and Light (FPL), contact FPL to determine their latest requirements regarding rebates for Thermal Energy Storage (TES) systems, chillers, DX, PTAC, and other HVAC systems, equipment with adjustable speed drives (ASD), high efficiency motors, etc.
         1) Determine and list if the equipment from the major manufacturers can qualify for the FPL rebates.

b. Identify any and all other possible sources for rebates, Federal, State, Local, etc.

7. Design for Test and Balance (TAB) Work
    a. Complete all testing and balancing with a commissioning plan as required by the Florida Building Code, Energy Conservation, edition in effect at time of permitting.
    b. Show all CFMs on floor plans in accordance with requirements in guideline BD-001, Permit Documentation Requirements, Phase-III – Complete Building Permit, HVAC Requirements.
    c. Show collars and manual VDs for flexible duct run-outs to CDs and from RGs.
    d. For OA systems with motorized 2-position (open closed) OADs, provide a manual VD in addition to the motorized OAD. Do not use the motorized OAD for balancing.
        1) Locate manual VD in the main RA duct upstream of the OA duct connection.
    e. If a system cannot be balanced using a flow hood, show locations for duct traverse test ports.
        1) Dimension the minimum upstream length (of two duct equivalent diameters) and minimum downstream length (of one duct equivalent diameter) of straight duct that are required for proper airflow measurement.
        2) For rectangular duct the equivalent diameter is defined as D=square root of (4xAxB/pi).
        3) Normally, fan powered relief air systems and outdoor air systems require duct traverse test ports for TAB work.
        4) For more accurate and/or continuous airflow monitoring or control, provide airflow-measuring station installed per manufacturer's recommendations.
        5) For chilled water systems – provide access to water flow meter measuring stations, which are located at each major system component location.

B. HVAC DESIGN – ROOM SPECIFIC

1. Media Center
    a. The central AHU serving all spaces in Media Center operates between the hours of 7:00 am and 4:00 pm.
    b. Provide a separate small DX system only in the Reading Room/Stacks areas to operate during AHU Off-hours (for humidity control).
        1) The EMCS shall control the DX unit when AHU is off during the unoccupied mode.
        2) The central system's (relative humidity) RH-sensor (located in the Reading Room/Stacks area) shall also control the DX system.
            a) The EMCS shall activate the DX system when the space's (RH) exceeds 60%.
            b) The EMCS shall turn the DX system off when the space's RH decreases below 55%.
        3) Size the DX unit for approximately 50% of the Reading Room/Stacks area, envelope transmission load in order to ensure adequate running time.
        4) DX unit shall be compatible with the EMS system for on/off operation.
        5) Duct smoke detectors for the DX systems (usually, with design capacity smaller than 2000 CFM) are not required.
            a) The EMCS has a 24-hour monitoring capability of the temperature, humidity, and smoke conditions in all Media Center spaces via space temperature & humidity sensors, and smoke detectors provided for the central AHU.
2. Dining Room and Kitchen

a. Provide separate systems for Kitchen and Dining that function together in accordance with the Detail for Cafeteria HVAC System Schematic.
b. Refer to District's EMCS control schematics for Kitchen Chilled Water Single Zone AHU and for Dining Chilled Water Single Zone AHU.
c. Transfer the conditioned relief air from the Dining Room to the Kitchen to supplement the required make-up air when the kitchen's AHU, hood supply, and exhaust fans are operational.
d. Provide air curtains (fly fans) at all doors from Dining and Kitchen to the exterior.
   1) Exception, air curtain are not required on emergency doors from dinning to the exterior, if the main entry to the Dining space is through an interior corridor system.
e. For other spaces in Dining and Kitchen areas, refer to items 9below.

3. Kitchen Manager’s Office
   a. Provide HVAC requirements from the main system.
   b. Monitoring of this space is required.
4. Dry Food Storage
   a. Provide a room dehumidifier.
5. PE Coach’s Office / Planning Room
   a. Provide small-dedicated PTAC unit with heating & cooling capacity.
   b. Properly size cooling equipment capacity based on 75°F indoor space temperature.
   c. Provide electric thermostat with sensor connected to the door into the space; provide a timer to the door sensor to shut off the PTAC unit if door is open more than 15 minutes.
   d. DX unit will cycle to maintain thermostat's set point.
   e. Monitoring of this space is not required; therefore, do not provide EMCS T-sensor or RH sensor.
6. Kiln Room Exhaust System
   a. Coordinate with the Architect the location of the Kiln Room, preferably on exterior wall.
   b. During normal school, hours provide cooling from central HVAC system in the Kiln Room.
   c. Design the Kiln Room exhaust system to operate independently from the central air conditioning systems, using outdoor unconditioned make-up air.
      1) Exhaust Air System: Provide ceiling exhaust fan with a gravity back draft damper, volume damper, and wall discharge cap (preferred) or roof vent with bird screen.
      2) Make-up Air System: Provide intake wall louver (preferred) with bird screen, motorized two-position (open/closed) damper 12" AFF with a grille.
         a) Separate air discharge and air intake with a minimum distance of 10'
      3) Electrically interlock (Division 26) the exhaust fan and motorized damper.
      4) Provide wall mounted 0-12 hour manual timer switch.
      5) When the timer switch is activated, the exhaust fan is on and the make-up air damper is open.
      6) Provide heat detector for fixed temperature only (200°F, no rate of rise feature) and connect to the school fire alarm system, coordinate with electrical.
   d. An exhaust hood over the kiln is not required.
   e. Insulate common walls between the kiln room and adjacent air-conditioned areas to prevent condensation and mildew growth on the kiln room walls.
      1) Provide vapor barrier on the kiln room wall coordinate with Architect.

7. Custodial Room / Janitor Closet Exhaust Systems
   a. Provide exhaust for all custodial rooms.
      1) To maintain custodial rooms at negative pressure provide make-up air or transfer air systems.
   b. When conditioned make-up air is used, exhaust custodial rooms located within the AHU zone per Table 403.3.1.1 of the Florida Building Code, Mechanical. In non-conditioned areas, or where non-conditioned make-up air is used, exhaust custodial rooms at 3 CFM/SF.
   c. For make-up air equal to 75 CFM or less, may use a 3/4" door undercut, if fire rating allows coordinate with Architect.
      1) For make-up air greater than 75 CFM, use a door grille or transfer duct/grilles.
   d. Provide ceiling exhaust fan with back draft damper.
      1) Provide exhaust ductwork with volume damper for balancing, and at the duct discharge provide roof or wall cap with bird screen.
      2) Layout the exhaust ductwork so the volume damper is above an accessible ceiling
      3) If that is not possible, provide ceiling access panel.
   e. Custodial exhaust system is part of the relief air system that provides proper pressurization and air balance for the AHU zone.
      1) Within the AHU zone, interlock the start/stop of the custodial exhaust fan with the open/close of OA damper or start/stop of the OA fan via the EMCS.
8. Toilet Exhaust Systems
   a. To maintain toilets at negative pressure provide exhaust systems with make-up air or transfer air systems. Do not provide supply air for single toilet rooms.
   b. When conditioned or non-conditioned make-up air is used, exhaust at 50 CFM per water closet or urinal (FBC-M, Table 403.3.1.1).
   c. In non-conditioned areas, or where non-conditioned make-up air is used, exhaust toilets at 3 CFM/SF but not less than 50 CFM per water closet or urinal (FBC-M, Table M403.3).
   d. Toilet exhaust system is part of the relief air system that provides proper pressurization and air balance for the AHU zone.
      1) Within the AHU zone, interlock the start/stop of the toilet exhaust fan with the open/close of OA damper or start/stop of OA fan via the EMCS; refer to item E.7.d.
      2) When combining multiple toilet exhaust systems, do not locate fan or motors in ceiling above classroom.
   e. Within the AHU zone, combine individual toilet exhausts to minimize the number of exhaust fans, and EMCS points for fan start/stop and fan status.
   f. When toilet exhausts cannot be combined per item e, provide individual ceiling exhaust fans.
      1) Control each fan from toilet light switch (or occupancy sensor) with 5-minute delay timer and speed controller for balancing.
      2) Coordinate with Electrical Engineer.
      3) Individual toilet exhaust fans are not controlled or monitored by the EMCS, and they are not included in the air balance analysis for the AHU.
   g. Provide combined toilet exhaust fans or individual toilet exhaust fans with back draft dampers.

h. Design the exhaust ductwork to include separate (duct mounted) volume damper for balancing each exhaust grille and/or exhaust fan, and at the duct discharge provide roof or wall cap with bird screen.
   1) Layout the exhaust ductwork so that the fan and volume damper are within 2' above an accessible ceiling
   2) If that is not possible, provide ceiling access panel(s).
i. To control noise from single toilets (without vestibule) adjacent to occupied spaces in Administration area refer to C.8.l.
   1) For single toilets in other locations with make-up air equal to 150 CFM or less, use a 3/4" door undercut if fire rating allows coordinate with Architect.
   2) For make-up air greater than 150 CFM, either use a door grille or transfer duct/grilles.

9. School Police Office/Surveillance Room
   a. During normal business hours, provide cooling and outdoor air via the Administration's AHU.
   b. After normal business hours, to offset computer equipment and security monitor loads, provide a dedicated DX system.
      1) Provide programmable thermostat.
      2) Provide T-sensor for monitoring via EMCS.
      3) Do not provide RH-sensor, unit will cycle to maintain the thermostat set point.
   c. To avoid potential damage to computer hardware caused by condensate, locate DX unit in (ceiling) space near the doorway.
      1) Do not route DX condensate drain line over electronic equipment area.
10. Electrical Rooms
   a. Review the heat load of electrical equipment rooms with transformers and provide a DX unit or another ventilation system to keep the room temperature below 90°F 24 hours a day 7 days per week.
   b. Mechanical Engineer to coordinate with the Electrical Engineer and Architect
   c. If using DX unit, locate equipment so as not to cause damage from the condensate of the refrigeration lines or drain lines to the electrical equipment in the room.
11. Golf Cart Storage/Charging Area
   a. Provide ventilation at the rate of five air changes per hour, this may be mechanical or natural.
   b. All fans shall have explosion proof motors
   c. The HVAC documents shall include a requirement for a permanent sign "No spark or flame producing equipment and materials are allowed in this space"
   d. Coordinate with the Architect.
12. ILS Communication Closet Room (CCR)
   a. Provide air conditioning for CCR from the AHU that serves the area.
      1) There is usually one CCR per building.
13. ILS Communication Equipment Room (CER)
   a. During normal business hours, provide cooling and outdoor air via the area's AHU.
   b. After normal business hours, to offset communication equipment loads, provide a dedicated DX system.
      1) Provide programmable thermostat.
      2) Provide T-sensor for monitoring via EMCS.

3) Do not provide RH-sensor, DX unit will cycle to maintain the thermostat set point.

c. There is only one CER and it is usually located in the administration building.

d. To avoid potential damage to communication equipment caused by condensate, locate DX unit in (ceiling) space directly adjacent to the CER.

1) Do not route DX condensate drain line over CER.

14. Chemical Storage Room

a. Provide continuously operating mechanical exhaust system connected directly to exterior of the building.

b. Monitor the fan operation using the building's EMS, which creates an alarm when the electrical current stops on the exhaust fans.

c. Exhaust system shall consist of dual exhaust fans with one single exhaust discharge (Primary and secondary fans).

1) Normal operating conditions (During occupancy), both exhaust fans exhaust a minimum of 110% of the supply CFM to the room, approximately 15 air changes per hour.

2) Off hours (Non-occupied times), the smaller of the two fans shall exhaust approximately 1/3 the occupied CFM rate.

d. Provide connection for vented flammable storage cabinet directly to the mechanical exhaust system for the room.

1) Provide vapor proof exhaust fan.

15. CCTV Control Room & Studio

a. Consider both rooms as separate zones and provide each room with its own VAV Box and corresponding EMS controls.

b. Provide a quiet environment in the studio area with maximum noise criterion level of NC20.

c. Coordinate HVAC equipment locations with production lighting and grid.

16. Mechanical Equipment Rooms (MERs)

a. The Engineer, not the contractor, shall provide detailed plans and sections of MERs including Air Handler Units (AHUs). There are no exceptions.

b. During Phase II, size MERs for proper service access, and properly locate MER doors to provide service access (e.g. for coil removal), coordinate with Architect.

c. Locate MERs on exterior walls with solid exterior doors with weather stripping and center overlapping astragal to minimize infiltration and to reduce condensation on AHUs and ductwork.

1) Provide conditioned air to MER coordinate with Architect.

2) To eliminate the creation of plenum space in MER, door grilles and open (un-ducted) wall grilles are not allowed.

d. For noise attenuation generated in MERs refer to C.8.n.

e. Show all ductwork double-line.

f. Show pipes, fittings, valves, specialties, etc. (2" and larger) double-line

1) Plans must show locations of main CHW shut-off valves, y-strainers, control valve in CHWR line with actuator in vertical orientation, and Venturi flow meter with proper straight pipe upstream and downstream lengths. In section show, flexible coil piping connections to allow clearance for coil pull space.

2) When access is to the backside of the AHU, locate the coil connections on the backside with the coil pull from the front side, refer to item "i" below.

g. Using shaded areas, show service areas per manufacturer's recommendations for maintenance, removal or replacement of the following:
    1) Coil
    2) Fan motor and drive
    3) Fan shaft and bearings
    4) Filters
    5) Control actuators
h. For multi-zone units provide 30" clearance at the AHU discharge end (SA) and locate the control actuators for the zone dampers in front of the AHU.
    1) Do not locate control actuators for the zone dampers on top of the AHU.
i. Provide a minimum of 30" of clearance on all sides of the AHU.
    1) The Engineer, with approval may reduce the 30" clearance in tight rooms, in this order: (1) inlet end (RA), (2) back side, and (3) discharge end (SA) except for multi-zone unit.
j. Show locations of starters, disconnects, EMCS panels, electric duct heater control panels, variable frequency drives, etc., and their working clearances per latest applicable revision of NEC.
    1) Coordinate with Electrical Engineer and EMCS Representative.
    2) Specify the proper equipment for the location and conditions or select different location for the equipment.
k. Provide housekeeping pad 6" larger than the AHU footprint and minimum 6" thick.
    1) The Engineer must verify that the 6" pad height will allow the proper size of condensate trap for the equipment selected as the basis of design.
l. For condensate, provide an open hub drain with a p-trap, and the lip at 1" AFF with a recessed dome strainer located next to the AHU housekeeping pad near the cooling coil condenser drain connection for continuation coordinate with plumbing design.
    1) Drain line shall have 1" air-gap above hub lip.
    2) Trap vent and trap primer are not required.
    3) Drain to nearest catch basin, if via roof drain system, provide an accessible backwater valve; coordinate with plumbing design.
m. Provide 3" floor drain with trap primer connected to sanitary system.
    1) Offset the floor drain vent below the roof to obtain a minimum of 10' separation from the outdoor air intakes.
    2) Slope MER floor to a floor drain; coordinate with Architect.
n. Provide hose bibb with tamperproof anti-siphon vacuum breaker.
o. Provide duplex power receptacle; coordinate with Electrical Engineer.

C. HVAC DESIGN – EQUIPMENT/CONTROLS
1. Equipment Identification Marks
    a. Define HVAC equipment using building number and equipment number. For example the first AHU and its associated systems in building 8 are identified as follows:
        1) AHU: AHU 8-1
        2) VAV Terminal Boxes : VAV 8-1-1, VAV 8-1-2, VAV 8-1-3, etc.
        3) Outdoor Air Fan: OAF 8-1
        4) Outdoor Air Damper: OAD 8-1
        5) Relief Air Damper: RAD 8-1

6) Toilet, Custodial and General Exhaust Fans: EF 8-1, EF 8-2, EF 8-3, etc

2. Equipment Schedules:
   a. Provide schedules on drawings, not in the project manual.
3. Installation Details:
   a. Provide details on drawings, not in the project manual.
   b. The engineer, not the contractor, shall provide proper detail design.
4. Control Schematics
   a. Provide Control Schematics on drawings and not in the project manual refer to Energy Management Control & System sections of DMS 23 09 00 and 25 50 00.
   b. Provide HVAC systems with individual classroom temperature control.
   c. Consider resource rooms as classrooms.
   d. Consider each side of a classroom with a moveable partition as two separate classrooms and provide independent temperature control for each.
   e. Serve adjacent auxiliary spaces from the classroom zone.
      1) Examples of auxiliary spaces are material storage, project storage, textbook storage, administrative storage, classroom toilets, mechanical equipment rooms (MERs), electrical equipment rooms (EERs), communication closet rooms (CCR), corridors, etc.
   f. The EMCS Vendor and/or the District's Mechanical Engineer will provide standard control schematics and specifications.
   g. The Engineer must edit and/or revise the standard control schematics, control sequences, and specifications to address the specific design requirements for each project.
   h. Provide EMCS conduits between buildings and the chiller plant as part of the electrical systems.
      1) Contact the EMCS Vendor for the number and size of conduits.
      2) Label EMCS conduits coordinate with Electrical Engineer.
5. Temperature Sensors, Relative Humidity Sensors and Thermostats
   a. For student areas, locate sensors away from primary exit doors to reduce damage.
   b. Locate sensors on interior walls and away from windows to eliminate solar influence.
      1) Sensors shall not be located on walls that have the other side exposed to the outdoors.
   c. Coordinate locations of sensors with Architect.
      1) Architect must show locations of sensors on architectural floor plans, to prevent locating sensors on HVAC floor plans behind chalk boards, tack boards, bulletin boards, etc. and inside of case work.
   d. H-Sensor: EMS Relative Humidity Sensor
      1) Provide one RH-sensor per AHU.
         a) For VAV systems, locate RH-sensor in a typical zone space or room.
      2) Gymnasium: Provide only H sensor.
      3) Kitchen: Provide one H-sensor.
      4) Dry Food Storage: Provide one H-sensor
      5) Auditorium: Provide one H-sensor
      6) Media Center: Provide one H-sensor
   e. T-sensor: EMS Temperature Sensor

1) All Classrooms
2) Administration Offices
3) Kitchen's Dry Food Storage
4) Kitchen's walk-in cooler and walk-in freezer
5) Administration's Data Processing Computer
6) ILS Communication Equipment Room (CER)
7) Kiln Room
8) Electrical Room

f. CO2 Sensor: EMS Sensor
   1) Provide C02 sensors to control make-up air intake for large volume single zone buildings.
   2) Use in Auditoriums, Gymnasiums.
   3) If used in Cafeterias, take care to coordinate the kitchen hood exhaust air requirements.
   4) If used in classrooms take care to insure multiple sensors are used per zone for accurate make-up air control.

g. Pressure Differential Switch: EMS Sensor
   1) Use of Pressure Differential Switch to control Relief Air Fan speed and maintain constant 0.05 in wg building envelope pressure.
   2) Locate Pressure Differential Switch tube through the wall above exit doors which in-turn operates closest relief air fan in Custodial Closet. Duct relief air fan intake to adjacent hallway ceiling with fire and or smoke damper as required or Custodial Closet shall have transfer duct to hallway ceiling with fire damper.

h. HVAC thermostats shall be wall or unit mounted provided to control indoor design conditions in spaces served by dedicated DX or PTAC systems.

6. Liquid & Air Flow Meters, Pressure Gauges and Thermometers
   a. Provide required instruments in per HVAC Design Details and/or DMS Section 23 05 19 (15135).

7. Noise Attenuation of Mechanical Equipment
   a. Attenuate noise at the school's property line in accordance with city/county noise ordinance.
      1) If the city does not have a noise ordinance, apply the county noise ordinance of 55 dBA.
   b. Attenuate noise at physical education play courts and ball fields not to exceed 60 dBA.
      1) The noise level is a maximum value at any location -- not an average value.
   c. Design the classroom spaces for a maximum noise criterion level of NC35, with Music Band, Chorus Rooms, and Auditoriums of NC20 to NC25.
      1) Size ductwork and select air distribution devices (CDs, RGs, and EGs) to satisfy above maximum room noise criteria.
      2) Assume a room attenuation of 5 dB:
      3) Caution: To obtain the room noise level the dBs of multiple outlets in a room add them logarithmically.
   d. For attenuation, at the inlet to and the discharge from the AHU, provide the following minimum lengths of double wall ducts with a perforated inner wall and 1" thick insulation encapsulated in a Mylar sleeve.
      1) Duct liner exposed to the air stream is prohibited.

2) For additional details on electric duct heater installation in double wall ducts Refer to E.6.a.
3) Multizone : 20' RA duct, 0' SA ducts
4) Single Zone : 20' RA duct, 20' SA duct
5) VAV : 20' RA duct, 20' SA duct
6) If branch duct take-offs are necessary in the double-wall main duct, provide double-wall take-offs and double-wall branch ducts to obtain the minimum double wall lengths.
7) Show locations of double-wall ducts on floor plans. Note referring to “X feet of double wall duct” is not acceptable.
8) For quality control, double-wall ductwork must be factory made.
   a) Field fabricated double-wall ducts and fittings are not acceptable.

e. Noise attenuation; provide non-metallic flexible duct run outs from branch SA ducts to CDs and from RGs to RA ducts.
   1) The length of flexible duct must be no greater than 14 feet, per the FBC, 2017 Ed.
   2) For insulation, requirements refer to item F.6.
f. Route the main VAV high velocity supply air duct over non-sensitive noise areas (corridors, storage rooms, toilets, etc.).
   1) If no other alternative route is possible except over a noise sensitive area, then take measures during design to prevent potential noise problems
      a) Two possible options:
         (1) Using double-wall duct with a solid inner wall
         (2) Using a low frequency band silencer within the MER
g. The main low velocity return air ducts may cause a low frequency rumble, in noise sensitive areas, therefore, during the design phase take measures to prevent this problem with one of the following options:
   1) Single wall round duct or flat-oval duct
   2) Double-wall duct with a solid inner wall
   3) A low frequency band silencer within the MER
h. Coordinate with Architect the location of the outdoor chiller yard and the design of chiller yard equipment and enclosure, to maintain maximum 55-dBA-noise level at the school property line.
   1) To attenuate noise, the top of chiller yard enclosure wall shall be approximately 24" higher than the highest point of the chiller assembly when mounted on the concrete support pads.
   2) The design of chiller yard enclosure will affect the selection of chiller equipment; see D.5.d.
   3) If not feasible (in urban sites with close proximity of residential properties), with the District's Mechanical Engineer written approval, the Engineer may consider indoor water cooled chiller plant with outdoor cooling towers as an alternative; refer to item l below.
i. Coordinate with Architect the location of indoor chiller plant with outdoor cooling towers, and the design of cooling tower equipment and enclosure, to maintain maximum 55-dB-noise level at the school property line.

j. To prevent mechanical transmission of vibrations to the building structure, and vibrations that could cause excessive noise levels, provide vibration isolation systems, isolators, and/or supports for all rotating and reciprocating equipment.
    1) Provide vibration isolators between vibrating equipment and connected piping and ductwork.

D. CHILLERS

1. Chiller Plant (Indoor and Outdoor Type Chiller Plants)
    a. Show CHW and CW pipes, fittings, valves, specialties, etc. (2" and larger) double line
    b. Provide two spare CHW flanged connections; see item D.8.k for details (Emergency Portable Chiller Connections).
    c. Show locations of starters, disconnects, EMCS panels, chiller control panels, variable frequency drives, etc.
        1) Specify the proper equipment for the location and conditions or select different location for the equipment.
    d. Using shaded areas show working clearances for all electrical equipment per latest applicable revision of NEC, Coordinate with Electrical Engineer and EMCS Representative.
    e. For other than electrical equipment show clearances per manufacturer's recommendations, using shaded areas.
    f. Provide equipment housekeeping pads and/or supports. Coordinate with Structural Engineer.
    g. Show locations of pipe supports and provide pipe support details.
    h. Provide hose bibb(s) with tamperproof anti-siphon vacuum breaker(s) coordinate with plumbing.
    i. Provide duplex receptacle(s), coordinate with Electrical Engineer
    j. Provide service lighting for air-cooled chillers.
2. Indoor Chiller Plant (Water Cooled Chillers) in addition to D.1
    a. In Chiller Room, provide cooling from the central HVAC system.
    b. Provide roll-up door in front of each chiller.
        1) Size door to allow chiller replacement as a single unit, coordinate work with Architect
    c. Provide a rolling trolley and hoist system, attached to the building structure, and sized for the largest and heaviest chiller component, coordinate with Structural Engineer.
    d. Provide a water treatment station to chemically treat water for each cooling tower.
    e. Water Treatment Station shall not be located next to any electrical device; maintain a minimum distance of 10'.
    f. Provide Water Treatment Chemical containers with spillage containment tanks.
    g. Provide one cooling tower per chiller with dedicated condenser water piping to and from designated tower.
    h. Condenser water return piping inside chiller plant shall not be higher than cooling tower sump.
    i. Provide emergency exhaust and ventilation system with wall intakes and roof discharges and with non-conditioned outdoor air make-up system.
        1) Exhaust air from the floor and the ceiling level to the outdoors, refer to ASHRAE 15
        2) Provide wall mounted electric thermostat.
        3) Exhaust fan will cycle to maintain thermostat's set point.

4) Provide a refrigerant monitor and alarm control panel that overrides the thermostat and starts the fan in the emergency exhaust mode, in case of a refrigerant leak.
5) Provide rupture disk piping from each chiller to outside of building.

j. Provide 4" floor drain(s) with trap primer(s) connected to sanitary system.
1) Slope floor to the floor drain(s) coordinate work with plumbing and architectural design.
2) Provide potable water hose bib inside room or directly outside building next to garage doors.
3) Provide water meter on make-up water line to chilled water system located no higher than 5’AFF.
4) Provide water meter on main cooling tower condenser make-up water line located no higher than 5’ AFF.

3. Outdoor Chiller Yard (Air Cooled Chillers) in addition to D.1
   a. Show required clearances.
      1) Minimum 10' clearance between air-cooled chiller and solid wall of chiller yard enclosure or adjacent building wall
      2) Minimum 10' clearances between multiple air cooled chillers
      3) Clearances recommended by chiller manufacturer shall apply if they are greater than those required by the District
   b. Provide concrete support piers for chillers per SDPBC Detail #39.
   c. Provide concrete slab on grade inside the chiller yard enclosure.
   d. Provide concrete pad outside entrance gate full width of gate opening.
   e. Provide chiller yard enclosure designed for easy authorized access, proper air circulation and for sound attenuation; refer to item C.8.a, coordinate with the Architect and Structural Engineer.
   f. Provide chiller yard enclosure with grade level scuppers to drain rainwater
   g. Provide paved access and 8 foot wide concrete landing with access doors.
   h. Provide chilled water chemical pot feeder with easy access from plant door.
   i. Coordinate with architectural and landscape design to prevent any overhangs (trees, structures, etc.) from intruding into the outdoor chiller yard enclosure.
4. Chillers, General Requirements (Air Cooled and Water Cooled)
   a. Calculate chiller capacity using a nationally recognized HVAC load calculation program as provided by Trane, Carrier, or some other similar source.
   b. HCFC and HFC refrigerants are acceptable, DO NOT use CFC refrigerants.
   c. Select chillers to allow for expandability if a future school expansion is planned and costs are affordable for the present project.
5. Air Cooled Chillers (in addition to item D.4. requirements)
   a. For systems where the total cooling load is between 30 tons and 600 tons of refrigeration, select air-cooled chillers in compliance with the Florida Building Code, Energy Conservation and ASHRAE 90.1.
   b. To meet 55-dB noise criteria at the property line the air cooled chillers may require optional factory sound reduction package to include, baffle hoods and/or noise reduction blankets on compressors, low noise condenser fans, and fan discharge extension hoods or equivalent options offered by equipment manufacturer.
   c. Define the following data in the equipment schedules:
      1) Tons, GPM, EWT, LWT, WPD, OAT, MCA/MFS/VOLTS/PHASE, 0.00025 fouling factor.

a) For a 50% vented enclosure, use 95°F OAT.
b) For 3-sided (or less) solid wall enclosure use 95°F OAT.
c) For 4-sided solid wall enclosure use 105°F OAT.

6. Water Cooled Chillers (in addition to item D.4. requirements)
   a. For systems where the total cooling load exceeds 600 tons of refrigeration, select water-cooled chillers in compliance with the Florida Building Code, Energy Conservation and ASHRAE 90.1.
   b. Define the following data in the equipment schedules:
      1) CHW: Tons, GPM, EWT, LWT, WPD, MCA/MFS/VOLTS/PHASE, 0.00025 fouling factor
      2) CW: GPM, EWT, LWT, WPD, 0.00025 fouling factor.
7. Cooling Towers
   a. Provide one stainless steel cooling tower per water-cooled chiller, with interconnecting piping independent of other adjacent chillers and towers within the same plant, do not use dual-cell or common sump towers.
   b. For noise sensitive areas, consider over sizing cooling tower capacity so tower fan will always run slow.
   c. Provide frequency drives for each cooling tower fan motor, drive will be used for soft start, speed control or both.
      1) Adjustable pulleys not allowed.
      2) For additional requirements, refer to Specifications, section 23 65 00.
      3) Provide condenser water system per item D.9.
   d. Define the following data in the equipment schedule:
      1) GPM, EWT, LWT, 80°FWB, HP/VOLTS/PHASE, variable speed drive motors
   e. For cooling tower drain(s) (non-valved emergency overflow and valved drain), provide 4" open hub drain(s) with trap primer(s), and recessed dome strainer(s).
      1) Connect to sanitary system coordinate with plumbing design.
   f. Provide cooling tower enclosure, design for easy authorized access, proper air circulation, and for sound attenuation; refer to item C.8.p, coordinate with the Architect and Structural Engineer.
   g. Coordinate with architectural and landscape design to prevent any overhangs (trees, structures, etc.) from intruding into the cooling tower enclosure.
8. Chilled Water (CHW) Systems
   a. Above 30-tons, CHW systems are preferred in lieu of DX systems.
   b. Provide one page in Mechanical plans illustrating entire campus and chilled water piping layout.
   c. System design shall be based on central station or single zone variable air volume VAV.
   d. For elementary and middle schools design CHW systems with a cooling coil minimum temperature difference of 12°F, to reduce pipe and pump sizes, and pump horsepower.
   e. For high schools design primary/secondary, CHW loop systems (preferred).
      1) Variable flow primary chiller loop shall have minimum temperature difference of 10 deg F and variable flow secondary loop shall have a minimum cooling coil temperature difference of 12 deg F.
   f. Size CHW pipe: Note the GPM for constant flow systems and maximum GPM for variable flow systems.

1) For below grade (exterior) CHW pipe, locate pipe offsets and swing-elbow take-offs to allow for proper thermal expansion-contraction.
    a) Pre-insulated welded steel pipe lines (up to 175' of straight run) with 36" of cover do not require thrust blocks, thermal expansion-contraction pipe offsets or swing elbows.
2) For above grade (interior) CHW pipe, locate pipe anchors, pipe guides, swing-elbow take-offs, and thermal expansion-contraction devices.

g. Do not route CHW pipe under the building slab except to penetrate the exterior wall.
h. Do not route CHW pipe under sidewalks except to cross beneath them.
i. To accommodate an emergency portable chiller, provide two spare CHW flanged line-size connections with butterfly valves and blank flanges (High and low side of pumps).
j. Insulate CHW piping.
k. Insulate CHW equipment (pumps, air separators, expansion tanks.
l. Provide instruments for the chilled water systems to include temperature sensors, flow meters, pressure gauges, and thermometers.
m. For systems with pump suction diffusers, provide note that reads “AFTER CHW SYSTEM FLUSHING AND PRIOR TO CHW SYSTEM BALANCING, REMOVE THE SCREENS FROM THE AHU STRAINERS AND HANG THE SCREENS NEXT TO THE STRAINERS".

9. Condenser Water System
    a. Design condenser water piping system so that any cooling tower can be isolated and can serve any chiller.
        1) For screw type chillers provide condenser water flow control (GPM) with butterfly control valve and fast response electric actuator (Bray or equal) controlled directly from the chiller (not via EMS) with refrigerant (evaporator/condenser) differential pressure signal.
    b. For CW, type pumps provide basket strainers.
    c. For CW, chemical treatment system, provide 4" open hub drain with trap primer and recessed dome strainer.
        1) Connect to sanitary system coordinate with plumbing design.
10. Pumps
    a. Define the following data in the equipment schedules:
        1) GPM, TDH, pump RPM, BHP, pump performance chart, motor RPM, motor HP/VOLTS/PHASE.
    b. In addition to duty, pump(s) provide one stand-by (back-up) pump for each chilled water system (CHW) and for each condenser water (CW) system.
    c. Pump construction and material details:
        1) Do not use vertical pumps due to high maintenance replacement costs and long deliveries of proprietary pump seals.
    d. CHW pump suction shall have a strainer or suction diffuser.
11. Ice Storage Systems
    a. Use food safe Glycol as fluid used in chiller to produce ice.
    b. EMS system shall access chiller Manufacturer’s control panel to monitor unit’s performance.
    c. An alarm shall be generated by EMS system if chillers or pumps fail to start and notify District’s School Police

E. AIR HANDLERS

1. Air Handling Units (AHUs)
   a. Design the HVAC system so that AHUs can operate independently of each other and still maintain proper air balances within each AHU zone.
   b. Define the following data in the equipment schedule: CFM_{SA}, CFM_{OA}, TSP, ESP, fan RPM, fan BHP, fan performance chart, motor HP/VOLTS/PHASE, motor RPM, filter APD, cooling coil data, and electric duct heater data.
   c. Supply air CFM from AHU must not exceed the design sensible load requirements.
      1) The CFM_{SA} in the equipment schedule is the concurrent block CFM with the allowed diversity that the AHU is selected on, and it is less than the supply air CFM in the air balance summary table shown on the individual HVAC plan sheets.
   d. List all filters APD separately, do not include in the ESP.
      1) Define all AHU components so the sum of the ESP and the component APDs equals the TSP.
   e. Attenuate noise generated by AHUs.
   f. Provide central station AHUs with the following features:
      1) Casings for coil section and all sections downstream from coil section shall be double-wall with solid inner wall and 2" thick, 1.5 PCF insulation
      2) Sloped, insulated, and double-wall stainless steel condensate drain pans with anti-microbial coating.
      3) Field installed insulated copper condensate drain line with trap; refer to DMS Section 23 21 13.
      4) Access modules (min. 15" width) with access doors to entering air and leaving airsides of the cooling coil, as listed in items 11 thru 14 below.
         a) Bolted panels in lieu of access doors are not acceptable.
      5) 4" thick, MERV 10 air filters in accordance with ASHRAE 52.
      6) High efficiency inverter duty motors
      7) Differential pressure gauge for air filter pressure drop per item E.8.f.
      8) Fan modules with internal vibration isolation
      9) F&BPD modules with blade jam and edge seals.
         a) Maximum leakage rate shall be 5 CFM/SF of blade area at 1" WG.
         b) In order for an external F&BPD to work properly, the by-pass duct connection must be located upstream from coil face motorized damper.
      10) Multi-zone damper module with blade jamb and edge seals
         a) Maximum leakage rate shall be 9 CFM/SF of blade area at 1" WG.
      11) For AHUs with F&BPDs (CHW), provide the following:
         a) Mixing/filter module with door
         b) External F&BPD module
         c) Medium access module with door
         d) Coil module
         e) Medium access (vertical or horizontal) module with door
         f) Fan module with door
      12) For VAV AHUs (CHW & DX), provide the following:
         a) Mixing/filter module with door
         b) Medium access module with door
         c) Coil module

d) Medium access (vertical or horizontal) module with door
e) Fan module with door

13) For Multi-zone AHUs (CHW & DX), provide the following:
   a) Mixing/filter module with door
   b) Fan module with door
   c) Medium access module with door
   d) Multi-zone coil module with door downstream of coil and equalizing baffle in hot deck
   e) Multi-zone damper module

14) For 100% Outdoor Air AHUs (DX), provide the following:
   a) Flat filter module with door
   b) Medium access module with door
   c) Cooling coil module
   d) Hot gas reheat coil module
   e) Fan module with door
   f) Motorized damper

2. VAV Systems
   a. To reduce air turbulence at the AHU discharge and decrease noise provide air foil plug fan for VAV systems or forward curved fan for constant volume systems, limit the outlet velocity of the fan to 3000 FPM, and size the supply air (round or oval) duct per item F.4.d.
   b. Locate static pressure sensor in high velocity supply air duct approximately 2/3 downstream of the AHU.

3. VAV Terminal Boxes
   a. Define the following data in the equipment schedule:
      1) Box: Minimum CFM, maximum CFM, pressure differential at maximum CFM, discharge and radiated sound powers at 1" WG differential pressure for octave bands 2-7
      2) Electric Heater (EH): KW/VOLTS/PHASE, control steps, EAT, LAT.
   b. Do not locate VAV boxes with bottom access to be above the ceiling light fixtures, etc., and provide working clearance for electric duct heaters. Coordinate HVAC floor plans with reflective ceiling plans.
   c. At the inlet to the VAV terminal box, provide rigid round duct equal to the inlet diameter of the VAV box with minimum straight length of 3 feet or 3-duct diameters (whichever is longer).

4. DX Systems
   a. Types of systems:
      1) Split System Single Zone: Provide dual refrigerant circuits, 100%-75%-50%-25% capacity steps, and face-split coil.
      2) Rooftop (RTU) Single Zone: Provide dual refrigerant circuits, 100%-75%-50%-25% capacity steps, and face-split coil.
         a) Provide outdoor air hood with motorized OAD and manual VD.
         b) Mount the motorized OAD inside the RTU.
      3) Split System VAV: Provide dual refrigerant circuits, 100%-75%-50%-25% capacity steps, and row-split or intertwined. Do not reduce airflow across cooling coil, use bypass between R/A and S/A ducts coil.

4) If four capacity steps are not available, provide hot gas reheat coil (not hot gas bypass).
5) 100% Outdoor Air Unit: Provide dual refrigerant circuits, 100%-75%-50%-25% capacity steps, row-split or intertwined cooling coil, and hot gas reheat coil.
6) Provide capacity steps using either multiple hermetic compressors or semi-hermetic compressors with electric un-loaders.
   a) Suction un-loaders are not acceptable.
   b) Hot gas bypass does not provide a capacity step.
7) Small capacity, constant volume DX systems, with single refrigerant circuit, controlled with thermostats, are used in the following areas:
   a) Administration's Data Processing (DP) Room
   b) ILS Communication Equipment Room (CER)
   c) Kitchen's Dry Food Storage
   d) Media Center (see item B.1. for details)
   e) Kitchen Manager's Office
   f) PE Coach's Office/Planning Room
   g) Interior Electrical Equipment rooms with heat producing transformers; refer to item H.2.y
   h) In areas a, b and c above, provide additional T-sensors for monitoring via EMCS, for additional details refer to criteria for specific areas listed above.
8) Small capacity DX systems usually will not require smoke detectors; refer to item F.3.

5. Coils
   a. Select cooling coils based on 45°F EWT.
   b. Define the following data in the equipment schedules:
      1) Cooling Coils: Provide computer printouts.
         a) Air: Total MBH, CFM, EATs, LATs, FPF (144 max), rows (8 max), APD (1.25" WG max), coil face velocity (550 FPM max)
         b) H_2O: GPM, EWT, LWT, WPD (15' max)
      2) Hydronic Heating Coils: Provide computer printouts.
         a) Air: MBH, CFM, EAT, LAT, FPF, rows, APD
         b) H_2O: GPM, EWT, LWT, WPD
      3) Hot Gas Reheat Coils: Provide computer printouts.
         a) Air: MBH, CFM, EAT, LAT, FPF, rows, APD
      4) Heat Pipe Coils: Provide computer printouts.
         a) Air: MBH, CFM, EAT, LAT, FPF, rows, APD
   c. Condenser coils: refer to DMS Section 15682 for coating requirements.
6. Electric Duct Heaters
   a. Locate electric duct heaters (EDHs) in supply ducts, inside the mechanical equipment rooms, downstream from the smoke detector and upstream from the supply air T-sensor.
      1) For installation of EDHs inside the double wall ducts provide solid inner liners that start 6" upstream and end 6" downstream from the EDH.
      2) For multi-zone systems, provide EDH in each zone.
      3) For VAV systems, provide EDH in each VAV box.

4) Provide working clearances for EDHs per NEC, Article 110-26.

b. Define the following data in the equipment schedule:

1) CFM, EAT, LAT, APD, control steps, KW/VOLTS/PHASE.

2) Limit the air temperature rise not to exceed 30 to 35 deg F. Size EH at approximately 1kW per each 100 CFM of airflow, resulting in average temperature rise of 32 deg F.

7. Fans

a. Use ceiling and inline fans rather than roof-mounted fans.

1) Do not install in-line fans in ceiling spaces above classrooms.

2) Install inline fans in horizontal ducts that are within 2' of the accessible ceiling.

3) If ceiling space is not accessible, provide ceiling access panel.

4) Exceptions are roof-mounted fans for the kitchen hood, dishwasher, and fume hoods.

b. For small fans use direct drive fans rather than belt drive fans.

1) Provide volume damper for TAB (no speed controllers).

2) Exhaust fans require a back draft damper.

c. Provide fan interlocks for each fan controlled by the EMCS system.

1) Also, provide fan status for all fans with airflows of 300 CFM and larger that affect building pressurization and are part of the air balance for the AHU zone.

2) Fans that utilize non-conditioned air and are not interlocked with zone AHUs do not require status monitoring.

d. Define the following data in the equipment schedule:

1) CFM, ESP, motor HP/VOLTS/PHASE, motor RPM, fan RPM, fan performance chart (major fans only)

e. The outlet velocity of the fan in a VAV type AHU should not exceed 3000 FPM.

f. All variable speed fans shall have inverter duty rated motors appropriate for the application.

8. Air Filters

a. Select, install, and maintain air filters, in keeping with LEED for Schools Indoor Environmental Quality Credit 5 Indoor Chemical and Pollutant Source Control.

b. Filters installed in HVAC equipment shall be Minimum Efficiency Reporting Value (MERV) 13.

c. AHU filters shall be an industry standard size, refer to DMS Section 23 40 00.

d. For VAV systems with VFDs, select fan motor HP based on loaded filters (0.6" WG).

e. For constant volume systems, select fan motor HP based on clean filters.

f. To facilitate the maintenance of clean air filters provide differential pressure gauges connected to the filter modules with metal tubing refer to DMS Section 23 05 19.

F. DUCT WORK

1. Dampers

a. Provide manual Volume Dampers (VDs) where required for test and balance (TAB) work.

b. Provide gravity back draft dampers where required (exhaust fans, gravity relief air systems, etc.)

c. Where required provide two position (open/closed) motorized dampers (MDs) or modulating motorized dampers for air flow (CFM) control.

   d. Layout the ductwork so that all dampers are located above accessible ceilings, or provide ceiling access doors
      1) To service motorized dampers provide duct access panels.
2. Fire Dampers (FDs) and Smoke Dampers (SDs)
   a. Design shall comply with FBC-Building Chapter 7, FBC-M chapter 6, NFPA 101, NFPA 90A, and NFPA 92.
   b. At duct penetrations through fire-resistance-rated assemblies, provide required fire dampers. Show fire-resistance rating of all walls as a line type on mechanical plans.
   c. At duct penetrations through smoke barriers, provide required smoke dampers.
   d. At smoke partitions, provide smoke dampers in air transfer openings.
      1) At duct penetrations through smoke partitions/corridor, enclosures (required to have smoke draft control doors) provide smoke dampers if there are duct openings serving the corridor.
      2) Smoke dampers are not required if there are no duct openings serving the corridor.
   e. Type 'B' fire dampers with blade stack configured out of the air stream are standard.
   f. In low velocity ducts with a depth of at least 13" and District's Mechanical Engineer approval, the designer may use Type 'A' fire dampers with blade stack intruding into the air stream.
   g. Layout the ductwork so all fire and/or smoke dampers are located above accessible ceilings, or provide ceiling access doors.
      1) To service fire and/or smoke dampers provide duct access panels.
3. Smoke Detectors, Heat Detectors and Smoke Control Systems
   a. Provide smoke detectors in the supply and return systems of the air handling equipment; refer to FBC-M 606.2 and NFPA 90A 6.4.2.
   b. In boiler and kiln rooms of non-sprinklered, buildings provide heat detectors connected to the school fire alarm system.
   c. For a stage area greater than 1000 sq ft or with a height greater than 50', provide a fan powered smoke control emergency ventilation system.
      1) The designer shall also comply with NFPA 92A, 92B, and 204.
      2) Interlock smoke evacuation exhaust fans with stage sprinkler system flow switch and with manual test switch.
      3) Smoke evacuation exhaust fans shall include back draft dampers and full size duct openings just below the bottom of the deck.
      4) For make-up air provide roof intake ventilator(s) (Greenheck model WIH with 2000 sq. in. throat, or equal) on roof curb with transition duct to a 1600 sq. in grille 10 ft above the stage floor with motorized damper to open and close with smoke evacuation fan operation.
      5) The designer may use roof vents only with written approval of the District's Mechanical Engineer.
4. Ductwork Construction - Supply Air (SA) & Return Air (RA)
   a. Refer to DMS Section 23 31 00 and SMACNA.
   b. Provide galvanized sheet metal ducts with flexible duct run out to CDs and from RGs.
      1) Without exceptions, ducts of the fiberglass board construction are NOT ALLOWED in SDPBC projects.
   c. To address noise attenuation, (at the inlet and discharge of AHUs) provide double-wall ducts; refer to C.8.g

1) Except for return air systems, all double wall and medium pressure, high velocity ductwork shall be flat oval or round with spiral seal ducts and welded fittings.

d. Provide non-metallic flexible duct run from branch SA ducts to CDs and from RGs to RA ducts.

1) Flexible duct is required for noise attenuation.
2) At branch duct connection, use collar with manual VD.
3) Use insulated flexible duct for supply air and non-insulated flexible duct for return air systems, for details refer to item F.6.

e. Provide smoke detectors and heat detectors at required locations.

f. Provide electric duct heaters at required locations.

g. Provide manual volume dampers and motorized dampers at required locations.

5. Ductwork Insulation

a. Supply Air Ducts; Insulation is always required.

b. Return Air Ducts.

1) Not required if located within the conditioned thermal envelope.
2) Exterior ducts; insulation is required, same as for supply air ducts

c. Exhaust Air Ducts; insulation is not required.

d. Outdoor Air Ducts

1) Non-conditioned OA; insulation is not required.
2) Conditioned OA with or without reheat, provide insulation the same as for supply air ducts.

e. Ceiling Diffusers and Return Grilles except those in RA systems per item c.1 above; insulate the back of the ceiling diffusers and return grilles.

f. Flexible Duct Run outs; insulation requirements are the same as for rigid metal ducts.

6. Ducted Return Air (RA) Systems.

a. Ducted RA systems are standard.

b. Design routing of the return air ductwork to allow the RA grilles to be located near the exterior walls and windows.

c. The designer may use an all plenum air system only with written approval from the District's Mechanical Engineer for specific application on project-by-project basis.

7. Outdoor Air (OA) Systems

a. Provide galvanized sheet metal ducts and plenums.

b. Typical outdoor air system shall include:

1) OA intake louver, consult with Architect.
2) Motorized OA two-position (open/closed) damper with duct access panel
   a) Do not use the motorized OA damper for balancing.
3) Straight duct section with duct traverse test ports or airflow measuring station (for minimum required straight duct lengths refer to airflow equipment manufacturer).
4) Three possible OA system options:
   a) Atmospheric type (without fan)
   b) Outdoor Air Fan (for VAV systems)
   c) Outdoor Air Unit (OAU) with filter section, cooling coil (to pre-cool and dehumidify OA), and OAU fan
5) Manual volume damper (provide manual VD in addition to motorized OA damper, see item F.1.c.1 above)

8. Exhaust Air Systems
    a. Provide galvanized sheet metal ducts except for special exhaust systems:
        1) For fume hood exhaust, kitchen hood exhaust and dishwasher exhaust provide stainless steel ductwork
        2) For design, requirements of exhaust systems in kiln room, custodial rooms and in toilets.
        3) Provide welded aluminum plenum box on the back of each exterior wall louver.
9. Relief Air Systems
    a. Relief air systems are required in buildings or spaces pressurized with Outdoor Air.
        1) Provide galvanized sheet metal construction.
    b. If the exfiltration (pressurization) air exceeds 0.15 CFM/SF for any AHU zone, provide fully ducted relief air system for that zone vented to the outdoors as in c and d below.
    c. Ducted Gravity Relief Air System**:** (Preferred because they are self-balancing with respect to unplanned leaks due to poor building construction)
        1) Provide system with the following features: ductwork (sized for 500 FPM), relief grille (sized for 0.025"WG), motorized two-position (open/closed) damper (controlled by EMCS), counterbalanced gravity back draft damper (set to open at 0.05"WG), roof or exterior wall discharge (sized for 0.05"WG) with ½" corrosion resistant bird screen.
        2) Interlock the open/close function of the motorized control damper with the open/close of the OA damper or with start/stop of the OA fan via the EMCS.
    d. Fan Powered Relief Air System are preferred standard design:
        1) System shall exhaust relief air from the main RA duct prior to the OA duct connection.
        2) System shall have the following features: 45° side-tap in the RA duct, inline fan with back draft damper, volume damper, and roof or wall discharge.
        3) For adequate maintenance access, locate the inline fan in the horizontal relief air duct to be within 2' of the ceiling.
        4) Show location of duct traverse test ports in accordance with item A.9.g.; interlock the start/stop of the relief fan with the open/close of the OA damper via the EMCS.
    e. Plenum Relief Air System (not preferred, requires pre-approval in writing by the District's Mechanical Engineer):
        1) CAUTION: Plenum relief air system triggers multiple code restrictions in architectural, HVAC, plumbing and electrical design, and results in significant cost increase.

G. GRILLES

1. Ceiling Diffusers (CDs)
    a. Use fixed blade type diffusers without damper or equalizing grid, aluminum construction (steel construction for fire-rated assembly), off-white color.
    b. Use collar with volume damper at SA branch duct and insulated flexible duct as run out to CD.
    c. For T-bar ceilings, provide 24"x24" extended panel and insulate back of CD, and extended panel - independent of ceiling grid.
    d. For other ceilings, secure CD to 1" x 1" x 18-gauge angles (located above the ceiling).
    e. Define CDs and CFMs on floor plans using the following format: CD/12x12/4W/300 CFM.
        1) For throws other than 4-way, show throw directions

    f. In corridors, locate CDs min. 12' away from exterior doors to prevent condensation on CDs.

2. Return Grilles (RGs)
    a. Use 45° fixed louvers, 2" spacing, aluminum construction (steel construction for fire-rated assembly), off-white color.
    b. Use collar with volume damper at the RA branch duct with flexible duct run out from RG.
    c. For T-bar ceilings, provide 24"x24" extended panel.
    d. For other ceilings, secure RG to 1" x 1" x 18-gauge angles (located above the ceiling).
    e. Define RGs and CFMs on floor plans using the following format: RG/12x12/330 CFM
    f. In corridors, locate RGs near exterior doors
3. Exhaust Grilles (EGs)
    a. Use 45° fixed louvers, 2" spacing, aluminum construction (steel construction for fire-rated assembly), off-white color.
    b. Provide separate volume damper for balancing each EG.
        1) Locate volume damper a minimum of five duct diameters from the EG.
    c. Layout the exhaust ductwork so the volume dampers are located above accessible ceilings, or provide ceiling access door (Most toilets have inaccessible ceilings.)
    d. Define EGs and CFMs on floor plans using the following format: EG/12x12/330 CFM
    e. Provide rigid duct connections to EGs.
4. Transfer Grilles (TGs)
    a. Use 45° fixed louvers, 2" spacing, aluminum construction (steel construction for fire-rated assembly), off-white color.
    b. Define TGs and CFMs on floor plans using the following format: TG/12x12/220 CFM
    c. Size TGs for a maximum of 0.025" WG and the duct for a maximum velocity of 500 FPM
    d. Show CFMs for TGs on plans to assure proper air balance
5. Door Grilles (DGs)
    a. Use 70° opposed angle, 1" inverted "V" louvers, double flange, aluminum construction, off-white color, Titus CT-700 or equal.
    b. Define DGs and CFMs on floor plans using the following format: DG/12x12/170 CFM
    c. Size DGs for a maximum pressure loss of 0.05" WG
    d. Show CFMs for DGs on plans to assure proper air balance
6. Door Undercuts (UCs)
    a. Limit door undercuts to 3/4", if fire rating allows, coordinate with Architect, which corresponds to 150 CFM at a pressure loss of 0.05" WG for an interior 3' x 7' door, and coordinate with Architect.
    b. Define UCs and CFMs on floor plans using the following format: UC/115 CFM
    c. Show CFMs for UCs on plans to assure proper air balance.
    d. UCs are allowed in fire rated doors but not in smoke doors.

H. HVAC CALCULATIONS
1. HVAC Cooling Load Calculations
    a. Provide computer calculations in accordance with ASHRAE's methodology.
2. Input Data for HVAC Load Program
    a. Summer Design Conditions
        1) Indoor Conditions:

a) Administration: 75° F_{DB} / 50% RH
b) Media Center: 75° F_{DB} / 50% RH
c) Classrooms, Shops and Labs: 75° F_{DB} / 50% RH
d) Dining: 75° F_{DB} / 50% RH
e) Kitchen: 80° F_{DB} / 50% RH
f) Gymnasium and Locker/Dressing Rooms: 75° F_{DB} / 50% RH
g) Auditorium: 75° F_{DB} / 50% RH
h) Electrical Equipment Rooms: not to exceed 80° F_{DB} even when central HVAC systems are off

2) Outdoor Conditions: 92°F_{DB} /80°F_{WB} (1% design point)
3) Note: Input the appropriate design outdoor conditions into the load program so that the output from the load program defines the outdoor conditions as 92°F_{DB} /80° F_{WB} at 1500 hours for July and August with south or west exposure.
4) Daily Range: 16deg F
5) Clearness Factor: 0.90

b. Winter Design Conditions
1) Indoor: 70° FDB
2) Outdoor: 41° FDB (99% design point)
3) Clearness Factor: 0.95
4) Note: Do not reduce heating capacity for heating loads from lights, equipment, and people.
5) Do not increase heating capacity by the use of pickup factors.

c. Ground Reflectance: 0.20
d. Latitude for Palm Beach County: 26.7° North
e. Longitude for Palm Beach County: 80.1° West
f. Elevation for Palm Beach County: 15 feet above sea level
g. People Loads:
1) Elementary Schools: SENSIBLE / LATENT LOADS
a) Student Areas: 190 BTUH / 190 BTUH
b) Administration: 250 BTUH / 250 BTUH
c) Kitchen: 250 BTUH / 250 BTUH
2) Middle and High Schools: SENSIBLE / LATENT LOADS
a) Student Areas: 250 BTUH / 250 BTUH
b) Administration: 250 BTUH / 250 BTUH
c) Kitchen: 250 BTUH / 250 BTUH
d) Wresting and Weight Rooms: 710 BTUH / 1090 BTUH
e) Dance and Gymnastics Rooms: 710 BTUH / 1090 BTUH

h. Occupancy Levels: Base Occupancy on:
1) Classrooms:
a) 25 students plus 1 teacher per classroom for pre-kindergarten through 8th grade, exceptional student education, science, art, etc.
b) 27 students plus 1 teacher per classroom in high schools.
2) Resource Rooms: 15 students plus 1 teacher per room.
3) Student Dining: The seating capacity of the Phase II furniture plan (usually 1/3 of the core student design capacity).

4) Staff Dining: The seating capacity of the Phase II furniture plan
5) Stage for Cafetorium: 30 students for non-working stage.
6) Gymnasium: Minimum of 120 students, plus 4 teachers, and the maximum on the bleacher seating capacity.
7) Auditorium: Seating capacity
8) Media centers: For the reading/stacks area, use the Phase-II furniture plan (usually 10% of the core student design capacity).
9) Music and Choral Rooms: Intermittent occupancy of 60 students for Elementary and 100 students for Middle and High Schools

i. Ventilation Rates:
   1) Provide outdoor air in accordance with the FBC-M section 403 or the latest revision of ASHRAE Standard 62.
   2) May use either "Ventilation Rate Procedure" or "IAQ Procedure"
      a) May use the occupant diversity factor to account for variations in occupancy within the zones served by the system
      b) 20 CFM_{OA}/person Administration
      c) Designer may use the design based on the time average conditions per ASHRAE 62 if known that peak occupancy meets the requirements of code for short-term duration.
      d) The Estimating such variations could include occupancy scheduled by time-of-day, a direct count of occupants, or an estimate of occupancy or ventilation rate per person using occupancy sensors such as those based on indoor CO_2 concentrations.

j. Outdoor Air:
   1) Calculate exhaust air (EA), transfer air (TA), and exfiltration air (XFA) to determine the correct amount of outdoor air (OA).
   2) Outdoor air is the maximum of either a) or b) below.
      a) OA = (CFM based on ventilation rate procedure or IAQ procedure)
      b) OA = EA + TA + XFA, where
         (1) EA: Toilets and custodial closets in conditioned areas, calculate exhaust air based on 2 CFM/sq. ft. or 50 CFM per water closet or urinal (whichever is larger)
         (2) TA: Transfer air from the system is usually zero. Exceptions are the dining and kitchen systems, and the gymnasium and locker/dressing room systems.
         (3) XFA: Building pressurization causes exfiltration (air leaks) from the system to the exterior preventing the infiltration of unconditioned outdoor air into the building. Calculate exfiltration air based on 0.1 CFM/sq ft.

k. Lighting Loads:
   1) Since lighting loads are a dominant factor in cooling requirements, the design team shall provide the SDPBC PM evidence that the project has undergone a thorough evaluation of day lighting and attendant controls designed to minimize the need for supplemental electrical lighting.
   2) Coordinate fixture selection with Electrical Engineer.
      a) Use light fixtures with energy savings 32 W, T8 lamps and electronic ballast
      b) A four-lamp fixture consumes 128 W

c) The ballast factor is 1

d) Appropriate values of Watts/room or Watts/square foot are acceptable

l. Miscellaneous Sensible Loads: Use documented electrical loads.

m. Miscellaneous Latent Loads: Usually zero.

n. To calculate the temperature rise across the fan, input the following parameters to the load program:

1) System Type	Fan TSP	Motor EFF	Fan EFF
2) Constant Volume	2.5"	0.85	0.60
3) Variable Air Volume	4.0"	0.85	0.60

o. Safety Factors: 0.0.

p. Heating Pickup Factor: 0.0

q. Computer/Equipment Loads:

1) ILS Communication Equipment Rooms (CER): If actual data is not available, use the largest of 13 W/SF or 5000 BTUH for equipment loads.

2) ILS Communication Closet Rooms (CCR): If actual data is not available, use the largest of 6 W/SF or 300 BTUH for equipment loads.

3) Classrooms including art, music, choral, exceptional student education, labs, etc: Use 8 computers at 200 W/computer

4) Resource Rooms: Use 4 computers at 200 W/computer (approx. 700 BTUH/computer)

5) Offices, Secretarial/Reception areas: Use 1 computer per staff member at 200 W/computer

6) Media Centers: Coordinate number of computers with the Phase-II furniture plan use 200 W/computer.

r. CCTV Loads:

1) In production room, review the electrical drawings (lighting) for studio lights.

a) Studio lights are additional loads to the general room lighting.

2) Control room; review the electrical drawings (power) for equipment connections.

3) Provide table with loads itemized.

a) For the load calculation, use the actual loads times a diversity of 1/3.

s. For cooling load calculations, assume year-round school schedule including summer months.

END OF SECTION