STATE UNIVERSITY CONSTRUCTION FUND

PROGRAM DIRECTIVES

DIRECTIVE 15H-2 Issue date: April 2014

AIR SYSTEMS

1. System Requirements

   a. Design heating and cooling (where required) systems to be either a variable air volume (VAV) or a dedicated outdoor air system (DOAS).

   b. Constant volume systems can only be used with SUCF approval.

   c. Include airflow measurement stations (AFMS) to measure the supply, return and outside air of each AHU in a VAV system and for a DOAS provide AFMS on the AHU supply and exhaust. Provide two independent AFMS for the outside air portion (minimum outside air and the economizer section). Specify the AFMS with the capability to measure the entire range of airflows.

   d. Specify a reheat coil for VAV boxes located in the following locations; perimeter, densely occupied, (i.e. classrooms, conference rooms), high ventilation rates (i.e. labs), and the highest floor level of the building.

   e. Specify all VAV's with an airflow monitoring station. VAV's equipped with a reheat coil specify an integral access door upstream of the coil and an air temperature sensor to allow for discharge air temperature control.

   f. Where fan coils are included in the project select the units based on operation at low fan speed.

   g. Where chilled beams are included in the project provide a drain pan piped to an acceptable point of discharge.

   h. Systems should be designed to be used in conjunction with a perimeter hydronic system to address building envelope skin loss and human comfort at exterior wall locations. Provide a control valve controlled by the room thermostat.

   i. Design the system to provide outdoor air quantities that conform to ASHRAE Standard 62-07. Maintain the required minimum outdoor ventilation quantities through the AFMS measurements. Utilization of outdoor air CO2 control is required in densely occupied spaces ($\geq$25 people/1000 sq. ft.). The Building Management System should have the capability of monitoring and comparing the room CO2 sensor readings to an outdoor air CO2 sensor for control and to detect

sensor failure. Upon detection of failure, the outdoor air quantities shall default to minimum outdoor air requirements listed in the ASHRAE 62-07.

j. The location of air intakes and exhaust outlets, as well as their separations shall be analyzed to assure MCNYS minimum requirements are being met. Do not locate intakes near building entrances, parking areas, bus stops, or loading zones. ASHRAE Fundamentals Handbook "*Airflow Around Building*" analysis methodology should be used to evaluate intake and exhaust locations. Select exhaust locations that minimize the potential for exhaust re-entrainment at the building intakes, operable windows, entry ways, and prevent accumulation on roof areas and at exterior gathering areas.

Projects with complex building configurations or closely spaced adjacent buildings may require a separate airflow study.

On laboratory building projects a separate airflow study is required of the laboratory exhaust systems to assess impacts of the exhaust on the project building and surrounding buildings. An airflow/re-entrainment study using either computational (numerical) modeling and/or physical (wind tunnel) modeling will be required for new buildings and existing ventilation system major modifications.

k. Prevent entrainment of rain and snow into the supply air stream due to ingestion and accumulation at air intakes. Locate the intakes to minimize ingestion, use aluminum ductwork with provisions for drainage and other methods (i.e. snow melting) as required to prevent ingestion into the air stream.

l. Outdoor air dampers shall be gasketed, opposed blade type to minimize leakage, prevent blockage and permit volume control.

m. For standard applications dehumidification is not required beyond the amount achieved from the AHU cooling coil. Humidification shall not be provided unless requested by the Campus.

n. Unit ventilators shall not be used.

o. Exhaust air energy recovery systems shall have energy recovery with at least 50% energy recovery effectiveness when the supply air flow rate exceeds the following values listed below.

% Outdoor Air at Full Design Airflow Rate					
≥30% and <40%	≥ 40% and <50%	≥ 50% and <60%	≥ 60% and <70%	≥ 70% and <80%	≥ 80%
Design Supply Fan Airflow Rate (cfm)					
≥5500	≥4500	≥3500	≥2000	≥1000	>0

Energy effectiveness shall mean a change in the Enthalpy of the outdoor air supply equal to 50% of the difference between the outdoor air and the return air enthalpies at design conditions. Provisions must be made to permit air economizer operation.

Systems not requiring exhaust air (enthalpy) energy recovery:

1) Commercial kitchen hood systems
2) Spaces not cooled and heated to less than 60°F
3) Hazardous exhaust systems

p. For laboratory, arts, health care and special conditioned spaces, see Directives 15H-7 “Special Air Conditioning and Ventilation” and 15H-8 “Laboratory Design”.

2. Air Handling Unit Requirements

a. Manufacturer’s standard size, modular units are preferred. Double wall, insulated construction, draw-thru units are preferred for most applications. Non-perforated inner walls shall be provided at cooling coil and humidifier locations.

b. Exterior units will require an insulated walk-in enclosure with sufficient space in the enclosure to perform any required maintenance. Provide an access door at a width greater than 24” wide where required for suitable access. Provide sufficient power and lighting within the enclosure for maintenance work.
All ductwork shall be located within the footprint of the AHU roof curb.

c. All units shall be ARI certified and UL listed.

d. All AHUs must be fully controlled by the Building Management System (BMS), using the BMS sensors and system controllers. Stand-alone, unitary, integrated or other AHU manufacturer provided controls are not acceptable.

e. Access doors (24 inch wide) shall be provided upstream and downstream of filters and coils to allow for coil cleaning. Provide full width door at fan section. Lights shall be provided within the fan cabinet, filter housing and wherever else needed.

f. For standard applications, filter shall consist of a disposable pre-filter (ASHRAE Std. 52.2 MERV 8) upstream of a cartridge filter (MERV 13). Provide differential pressure gauges across each filter bank for local monitoring and to alarm the BMS when the maximum allowable pressure drop is exceeded. Require specified equipment filters to be installed during all AHU operation (including construction and testing) and replaced prior to turning the facility over to the Campus. Include a spare set of filters for the turnover to the Campus.

g. Drain pans shall be full width and have enough axial length to collect condensate at the maximum coil air velocity. Drain pans shall be stainless steel, pitched to drain, and externally insulated.

h. Heating coils shall be freeze protected with propylene glycol based on ASHRAE 99.6% design heating dry bulb temperature. Hot water shall be used for heating/reheat. Steam coils shall not be used. Temperature control shall be by modulating control valves.

i. Cooling coils in most cases shall be designed around winter layup procedure which includes provisions for draining down the coils.

j. Provide dry bulb economizer control.

k. Fan and drive shall be internally spring isolated on a steel base with internal flexible duct connections. External duct flexible connections shall not be used except where necessary for seismic design purposes.

l. Face and bypass dampers shall not be used for temperature control.

m. Provide NEMA premium efficiency, (inverter duty NEMA MG-1 for VSD applications) motors. Use pulse width modulation variable frequency drives and provide isolation transformers where harmonics could be detrimental to Campus equipment. Provide line reactors/filters per manufacturer's recommendation when mounting location/distance requires. Provide bypass to allow equipment

operation with VSD removed from service. Do not locate drive inside AHU fan section enclosure. Provide shaft grounding ring for the motor shaft to provide a path to electrical ground for induced shaft currents.

n. All coils should be designed around using no greater than 12 fins per inch and 6 rows or less.

o. Forward curved fans should be avoided unless air foil or backward inclined fans are not available, or forward curved fans provide a significant performance advantage.

3. Air Distribution Requirements

a. Ductwork shall be designed to achieve a low pressure drop air distribution system (0.08 to 0.10” w.g./100 foot).

b. Design fully ducted supply and exhaust systems. Return plenums are acceptable; provide the ducted return(s) within 90 feet from the most remote space.

c. AHU sound attenuators shall be double-wall, packless where airstream contains moisture, dust, fumes or other significant levels of contaminants. Sound levels shall be as described in 15H-1 "General HVAC Requirements", using sound attenuators. VAV box outlet shall use manufacturer's sound attenuator option.

d. Plenum and duct lining shall not be used, except in the low velocity connection downstream of the VAV box where design analysis shows a sound attenuator alone cannot meet the required sound level. Lining shall be installed per SMACNA.

e. Ductwork insulation on rectangular ductwork shall be externally applied rigid board fiberglass or fiberglass duct wrap with a factory applied, reinforced aluminum foil vapor barrier anchored and sealed at all points. Round and oval ductwork insulation shall be externally applied fiberglass duct wrap with factory applied reinforced aluminum foil vapor barrier secured to ductwork per manufacturer's installation instructions.

f. All supply air ductwork utilizing duct wrap insulation shall have a 1.5 lb. per cubic foot density and for rigid board insulation a 3 lb. per cubic foot density. Insulation thickness shall meet Energy Conservation Construction Code of NYS required R value. Insulation is not required on the exterior of exposed ductwork in constantly conditioned spaces.

g. Mechanical room ductwork insulation shall be rigid board fiberglass and have a 3 lb. per cubic foot density. All insulation thickness shall meet ECCCNYS required R values.

h. SMACNA HVAC Duct Design and Construction Standards shall be followed for duct construction and support design. Minimum duct design is Pressure Class 2" w.g. for connection from VAV box to outlet. All ductwork from the air handling unit fan and/or stand-alone fan (supply, return and exhaust) to a main duct damper (control/mixing, smoke and fire) shall be designed for the maximum total fan output pressure. This is to prevent duct failure in the case where a main duct damper closes by design or malfunction. All other ductwork shall be designed for the maximum system external fan output pressure.

i. All rectangular ductwork shall be in accordance with SMACNA Standards with regard to duct gauge, reinforcement spacing, bracing, hangers and supports. All longitudinal seams shall be made with a Pittsburgh Lock (Type L-1). Transverse joints shall be in accordance with SMACNA HVAC Duct Design and Construction Standards for ductwork < 3" w.g. For ductwork rated at 3" w.g. and above, the transverse joints shall be made with the Ductmate, Ward, or Nexus ductwork connection system.

j. Round and oval ductwork shall be spiral seam. Spiral seam ductwork construction shall be in accordance with the latest SMACNA Standards. Drawband and crimp type transverse joints (RT-3 and RT-5 respectively) are not permitted. Pleated, adjustable, and mitered elbows are not permitted, and segmented elbows shall be constructed with five segments, minimum.

k. Flexible ductwork shall only be allowed to make the connection from branch ducts to diffusers and shall be a maximum of 3 feet long. Flexible ductwork shall have a maximum flame spread index of 25, a maximum smoke developed index of 50 and conform to UL 181 - Standard for Factory-made air ducts and air connectors. Flexible ductwork shall be vapor barrier jacketed, insulated and have a continuous inner core that shields the fiberglass insulation. Core shall be manufactured from a durable material that will not collect moisture or degrade in the air stream.

l. Branch Ducts and Volume Dampers: All branch duct takeoffs shall be made with 45° entry fittings; splitter dampers and extractors are not allowed. Volume dampers are required at each supply, return, and exhaust air sub main, branch main, and branch takeoff and must be shown on the floor plans and in the specifications.

m. All ductwork shall be sealed to Seal Class A in accordance with SMACNA standards regardless of the ductwork's static pressure rating. Require the ductwork leakage class to be Class 6 for rectangular ductwork and Class 3 for round ductwork.

n. Air Leakage Testing: On systems designed to operate at pressures greater than 3" w.g. test 25 percent of the system duct area for leakage in accordance with the latest edition of SMACNA's HVAC Air Duct Leakage Test Manual to determine if the installed ductwork system's leakage rate meets the specified leakage class.

o. Access doors shall be provided upstream of all in-duct-mounted equipment (fire/smoke dampers, coils, fans). Ceilings shall be marked to identify the location of this equipment.

p. All ductwork shall be designed to be inside the building envelope. Ductwork proposed for installation in locations outside the building (for example, below a slab or on a roof) requires Fund approval and must be the only option available. Consideration is to be given to IAQ, waterproofing, accessibility of duct and duct components and longevity. In the event that ductwork will be installed outside of building envelope the ductwork shall be double wall with insulation meeting the energy code between two solid metal walls. The exterior duct wall shall be stainless steel or aluminum. All joints shall be watertight.

q. Ductwork shall be protected during construction as required by Directive 15H-9 "Commissioning and Indoor Air Quality Testing."

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