Compliance: Outdoor air ventilation is to be introduced into each occupied building space in compliance with *ASHRAE Standard 62.1 – Ventilation for Acceptable Indoor Air Quality as well as ASHRAE Standard 90.1 – Energy Standard for Buildings.* The goal is to provide adequate quantity and quality of ventilation air in an energy efficient manner.

Forced Air Systems: Occupied areas and public spaces are to be served by forced air system(s). In exterior spaces, such is to be provided in addition to hydronic perimeter heating. If heated supply air is used to augment perimeter heating it must be strategically located and oriented to best serve areas of greatest heat loss (e.g. adjacent to windows).

Central Systems: As stated within the *HVAC Systems* section within these *General Guidelines e*ach building is to be served by a minimal number of high quality central HVAC systems rather than numerous smaller systems. Each central ventilation system is to typically include an air handling unit, a return and/or exhaust fan or fans, air supply, return and/or exhaust ductwork and terminal units and devices.

System Configuration: As stated within the *HVAC Systems* section within these *General Guidelines* HVAC systems are to be configured such that spaces with similar usage are served by a common dedicated unit. Spaces with significantly dissimilar usage types or schedules are not to be served by the same system.

Future Expansion: Within practical limitations each ventilation system is to be sized and configured to accommodate potential future expansion of load and/or infrastructure.

Future Conversion: Ventilation systems may be designed (sized and configured) for future space-type conversion. However, this is not allowed in cases where significant energy penalty would result. For example, a non-lab space is not to be provided with once-through ventilation "just in case" it might be converted into a wet lab in the future.

Air Handling Units: Central air handling units with design airflow greater than 5,000 CFM are to be custom units as specified within *Section 23 73 23 – Custom Air Handling Units* within these *Facilities Standards*. Air handling units with design airflow less than 5,000 CFM may be either modular or custom units. Exception: Units with energy recovery wheels or heat pipe coils are to be custom units. Draw-through is the default configuration. However, with the increased application of plenum fans (as opposed to housed centrifugal fans) in conjunction with AHU supply plenums blow-through configuration may be a viable option for improving airflow mixing. The designer must account for blow-though unit configuration which may discharge supply air into the duct system at a higher relative humidity than a comparable draw-through unit. Supply airflow can approach the saturation point unless heat is added or moisture removed downstream of the cooling coil.

DOAS: Installation of dedicated outdoor air and dual path ventilation system configurations are encouraged where applicable and beneficial to overall system performance. The installation of such systems is not to reduce the requirement for 100% economizer on systems with return air. (Reference paragraph below entitled *Economizers.*)

Equipment Location: As addressed within the *HVAC Systems* section within these *General Guidelines* mechanical equipment is to be located within indoor equipment rooms with the exception of roof mounted exhaust fans. However, it is acknowledged that for building renovation projects adequate space may not be available to comply with this requirement. This is particularly the case with air handling equipment incorporating one or more energy recovery wheels. Thus, it is deemed acceptable to locate sizable air handling unit(s) on the roof of existing buildings if there is no practical alternative. This presents two options: 1) Provide a structural "brick and mortar" penthouse mechanical room to protect these units from the weather and facilitate service or 2) provide outdoor units that are the equivalent of such equipment rooms in terms of quality and functionality. From this perspective an expensive unit becomes inexpensive in relative terms. When locating equipment on roofs sight lines and aesthetics must be key considerations. Approval of such is to be obtained from the Architect and Owner as design progresses. Provision of architectural screening or cladding may be required to gain such approval.

Access: Access from the building interior to roof mounted air handling equipment must be adequate to facilitate anticipated maintenance and repair activities. In many cases installation of full size interior or exterior stairs are required to satisfy this requirement. Reference *Roof Access* section within the *Building Elements* section within these *General Guidelines* for specific requirements. Ladders, platforms and walk ways are to be provided as required to provide safe and convenient transport to roof-mounted equipment access points. Particular attention must be given to transport of boxed air filters given the difficulty of handling these bulky items.

Energy Recovery: Ventilation system design are to incorporate energy recovery opportunities to the greatest degree practical. Reference the *Energy Recovery Systems* section within these *General Guidelines* for specific air distribution/exhaust system requirements related to energy recovery. As addressed in the section entitled *Laboratory Ventilation* within these *General Guidelines* general lab exhaust systems are be separated from fume hood exhaust systems to facilitate optimized heat recovery for each system type.

Economizer: Each air handling system for which a return fan is required (reference paragraph entitled *Return Fans*) are to include a <u>100% air-side economizer</u> unless the design of the air handling system precludes its use. Additionally, requirement for air-side economizer is to comply with the requirements of *ASHRAE Standard 90.1* at a minimum.

Minimum OA: "Minimum outdoor air dampers" are to be provided as applicable to ensure provision of and optimized control of required ventilation and makeup air during periods of reduced total outdoor airflow.

Air Stream Mixing: Inadequate mixing of return air and outdoor air streams at air handling units (AHUs) is the <u>single greatest recurring problem</u> the University has experienced with air handling systems over the years. Effective mixing of air streams is <u>essential</u> in preventing coil freeze-up problems and nuisance trip-outs of freeze protection safeties. For <u>mixed air units, t</u>he mixing area upstream of each AHU is to be configured such that air streams mix thoroughly prior to entering the unit. The University has found that, for the most part, standard mixing box design is woefully inadequate. A design that ensures good mixing typically requires increased length of the AHU/duct assembly and, in turn, increased space requirements within the mechanical equipment room. A down-sized equipment room is the worst enemy of good mixing. A configuration that introduces return air beneath outdoor air as the two air streams move into the mixing area is preferred. Dynamic mixing of the two air streams is essential. Optimized control damper selection (parallel vs. opposed blade), sizing and orientation is important in this regard. Air handling units in variable air volume (VAV) systems are especially susceptible to poor mixing. The use of special air blending devices located within air handling units or mixed air plenums is viable. However, the use of these devices is to be treated as a secondary rather than primary means of achieving thorough mixing. In other words, they may be viewed as "insurance" rather than an essential component. When used, the length of airflow downstream of the device is to be greater than the manufacturer's published minimum.

Fans: Housed centrifugal fans and plenum fans are both approved for use in air handling units and associated return/exhaust fans in ducted ventilation systems. Fan arrays are acceptable but are not necessarily to be treated as default design as seems to be the current trend in the industry.

Return Fans: Each air distribution system with return airflow rate of 3,000 CFM or more is to incorporate a return fan. The fan and ductwork is to be configured such that the fan is located in the return air path rather than the relief air path. In other words, it is a true return fan rather than a relief air fan.

EC Motors: As required by *ASHRAE Standard 90.1* fan motors that are 1/12 HP or greater and less than 1 HP are to be electronically commutated motors or have a minimum motor efficiency of 70% when rated in accordance with *Dept. of Energy 10 CFR Part 431*. The use of EC motors is generally encouraged for single phase motorized equipment.

System Effect: When ductwork is attached to the outlet connection of a housed fan, a length of straight duct is to be provided prior to the first fitting or transition, thus minimizing “system effect”. This maximizes efficiency and minimizes noise. The minimum length of this section of duct is to be calculated using the formulas provided within the chapter entitled *Duct Design* in the current edition of the *ASHRAE Fundamentals Handbook*. Typically, the application of these formulas yield a minimum straight duct length that is equal to 2 to 3 times the diameter of the equivalent round fan outlet opening. Adequate space must be provided within the mechanical equipment room to accommodate this. System effect on the inlet side of fans is also to be minimized by ensuring a uniform inlet air velocity profile. This applies to fans with either ducted or un-ducted inlets. Again, this requires adequate space within the equipment room.

Vibration Control: All sizable fans are to be supported by properly selected spring type vibration isolators in order to minimize transmission of vibration into associated equipment and building structures. Such isolation is much more critical on upper levels of a building than on lower levels. Thus, the University’s preference is that large rotating equipment be located in equipment rooms at the lowest level. Flexible duct connections are to be installed at points of connection between fans and associated air distribution ductwork regardless of location in order to minimize transmission of vibration into and throughout duct systems. Exception: Flexible connections may not be required for small in-line fans, roof exhausters and some fume exhaust fan installations.

Sound Control: The use of sound attenuating devices within supply and/or return air duct systems is often necessary. However, the best way to control noise is to not create it in the first place. When the efficiency of air distribution systems is maximized noise becomes much less of an issue. This is accomplished via proper fan selection/sizing, duct design and terminal device selection/sizing (i.e. variable air volume air terminal units, diffusers, registers, and grilles). As stated elsewhere, the allowable HVAC-related background noise level for a given type of occupancy must not exceed the guideline criteria provided within the chapter entitled *Sound and Vibration Control* in the current *ASHRAE HVAC Applicatio*ns Handbook. With rooftop HVAC units of any size/type, sound and vibration problems abound. Supply ducts oriented vertically downward consistently create problems. As a result, the University strongly discourages the installation of rooftop units. In such cases when a rooftop unit is permitted, special steps are to be taken to prevent these sound and vibration problems from occurring.

Dampers: Automated dampers are to satisfy the requirements of *Section 23 09 13 – Control Dampers.* Exception: Standard quality dampers are acceptable when factory-mounted on small roof exhausters and similar equipment. Gravity relief dampers are not allowed unless approved by Owner. If approved, gravity relief dampers are to be premium quality counter-balanced type.

Filtration: As a general rule, unless specific requirements dictate otherwise, supply airflow serving standard building environments is to be filtered by 4” pleated MERV 8 (30% efficient) pre-filters followed by 22” bag-type MERV 11 (65% efficient) secondary filters. Supply airflow serving special building environments (e.g. laboratories where cleanliness is more critical) are to be filtered by MERV 8 (30% efficient) pre-filters followed by MERV 14 (95% efficient) secondary filters. This more stringent level of filtration may also be required to comply with LEED requirements. Certain devices in return or exhaust systems may also require filtration. Heat wheels and heat pipe coils serve as examples. Such devices are to be protected by 4" MERV 8 filters. Secondary filtration is typically not required. Exceptions: 1) Secondary filters are typically not required for air distribution systems of less than 3,000 CFM total capacity. It is typically acceptable to filter supply airflow through these smaller systems with 4" MERV 8 (30% efficient) filters with no additional secondary filtration. 2) Filters serving small unitary equipment (e.g. fan coils) may be 2" or even 1" if limited space within these units dictates. Regardless, such filters are to be of the pleated type. (MERV Ratings are per *ASHRAE Standard 52.2.* Filter % efficiencies are dust spot efficiency ratings per *ASHRAE Standard 52.1.)*

Humidification: As stated within the section entitled *HVAC Systems* within these *General Guidelines* space humidification is not to be provided unless required for a specific application. When humidification is required it is to be provided by means of a steam-to-steam reboiler type humidifier with dispersion manifold located within the applicable air handling unit. Humidifier manifolds/dispersion devices are not to be located within air distribution ductwork.

Displacement Ventilation Systems: Use of displacement ventilation (DV) systems is encouraged where appropriate. DV systems may be treated as default approach ("plan A") for large spaces with high ceilings (e.g. atria) and spaces with high occupant densities (classrooms and auditoriums). DV systems may also be treated as default for introducing large volumes of air into spaces in which air turbulence is problematic (e.g. kitchen exhaust hood makeup, laboratory fume hood makeup.) Floor level diffuser location is default for occupied spaces. Ceiling level is allowed for kitchen, laboratory, and similar applications where floor level is impractical. DV systems are to be considered for any application where high air quality, minimal drafts and low noise are deemed important. Use of DV systems does not in any way reduce requirement for baseboard heating of exterior spaces as addressed in *Heating Systems* within these *General Guidelines*.

Intake Location: It is generally preferred that outdoor air intake openings be located well above ground level to avoid typical lower level contaminants as well as any intentional harmful contamination. When a ground level installation cannot be avoided, the bottom of each intake opening is to be located a minimum of 3 ft. above the adjacent ground level. When an areaway is used as a means of providing outdoor air to below-grade equipment, compliance with the dimensional requirements set forth in the *Areaways and Window Wells* section within these *General Guidelines* is mandatory. This includes a requirement that each areaway and/or window well be extended a minimum of 1 ft. above adjacent grade level to minimize the entrance of leaves, debris and drifting snow. When selecting locations for outdoor air intake openings, it is essential that prevailing wind direction, building configuration, adjacencies and sources of odors/contaminants be considered. Vehicle exhausts from streets and loading dock areas as well as exhaust from emergency generators are common culprits for causing indoor air quality problems. The same is true of laboratory fume exhausts. In compliance with applicable codes and standards, minimum distances from various sources of contamination (e.g. sanitary vents, toilet exhausts, etc.) are to be maintained. Coordination is needed between designers who locate sources of contamination (i.e. Architect) and those who endeavor to minimize their effect (Engineer).

Intake Louvers: Outdoor air intake louvers are to be sized generously to prevent the carryover of rain and snow into associated ventilation systems. Light powdery snow is especially difficult to remove from the air stream regardless of louver type. Thus, air velocity across the net free area of any intake louver is not to exceed 500 FPM. If, due to unalterable existing conditions, (such as historic preservation requirements) it is not possible to comply with this limitation, a louver rated for wind driven rain may be used. If a horizontal wind driven rain louver is used in such cases (only) the air velocity across the net free area must not exceed 700 FPM. If a vertical wind driven rain louver is used air velocity across the net free area must not exceed 900 FPM. In such cases special provision is to be made to capture rain and snow within the building and direct it to drain. Designs that incorporate louver air velocity in excess of 500 FPM require approval of *F&S Engineering*. Proper configuration and flashing of the outdoor wall sleeve and associated louver is critical, particularly when mullions or other vertical members are involved. Wall sleeves and louvers are often not flashed properly. Reference *Drawing 23 37 00-1, Louver Installation Detail*. Bird screen is to be installed at each outdoor air intake opening. It is to be installed on the exterior of louvers as required by *ASHRAE Standard 62.1* in order to prevent the roosting and nesting of birds which is a serious ongoing problem at numerous locations on campus. (reference the *Bird and Pest Control* section within these *General Guidelines*.)

***Outdoor Air Plenum*:** A plenum is to be provided inside each outdoor air intake louver to serve as a “stilling chamber” to remove entrained rain and snow from the air stream. Plenums associated with wall louvers are to be of adequate depth (in direction of airflow) to ensure that air velocity profile is consistent across the full face of the louver. Inadequate louver depth results in localized areas of high velocity flow. Outdoor air ductwork connected to the plenum is also to be sized and configured to facilitate even air distribution at the louver. It has been the University’s experience, plenum depth is often inadequate. This results in localized areas of high air velocity through the louver in the immediate area(s) of duct connection(s). Each plenum is to include a basin at the bottom designed for collection and re-evaporation of snow and water. Where substantial entrance of snow or water is anticipated a piped drain that directs water to an interior floor drain is to be provided. In cases where a wall louver is dedicated to a single outdoor air duct, it is preferred that a full size transition fitting be used in lieu of a “box plenum”. In such cases the bottom of the transition fitting is to be pitched toward the louver such that water drains back outdoors. As addressed in the paragraph above entitled *Intake Lou*vers proper configuration of the duct/louver connection is critical. An access door is to be provided at each plenum/duct to facilitate cleaning of the louver / bird screen and be as large as practical. Plenums must have adequate structural strength to support the weight of service personnel who enter to perform maintenance/cleaning. Reference *Drawing 23 37 00-2, Plenum Construction Detail*.

Roof Intake: When an outdoor air intake hood or louvered penthouse is located at the roof level of a building it is to be installed in a manner that minimizes the potential for snow penetration. Toward this end, the lowest point at which air may enter the device is not to be less than 24” above the adjacent roof surface. In locations which are vulnerable to snow drifting this dimension is to be increased as appropriate. When an intake hood is used the air velocity across the total effective intake opening is not to exceed 300 FPM and the associated throat velocity may not exceed 600 FPM. It is to be noted that louvered penthouses are particularly vulnerable to rain and snow penetration due to increased velocity of wind at the roof level in conjunction with a design that allows air to blow through the device horizontally. (i.e. air enters the windward side and exits the leeward side). For this reason, the use of louvered penthouses is generally discouraged. When these devices are used they are to incorporate wind driven rain louvers. The air velocity across the total effective intake opening is not to exceed 300 FPM and the associated throat velocity may not exceed 600 FPM. Each vertical outdoor air duct or plenum is to include a basin at the bottom designed for collection and re-evaporation of snow and water. Where substantial entrance of snow or water is anticipated, a piped drain is to be provided that directs water to an interior floor drain. One or more hinged access doors are to be provided as required to gain full access to the motorized outdoor air damper and collection basin. Reference *Drawing 23 37 00-03, Roof Intake Detail*.

Relief Location: Each relief air opening is to be located, at an absolute minimum, 10 ft. from the nearest outdoor intake opening. Consideration is to be given to the prevailing wind direction, building configuration, intake and relief opening orientation, etc. when locating outdoor air and relief air openings to minimize the potential for recirculation of relief air back into the intake air stream. Such consideration will often dictate a separation distance that exceeds that which is required as a minimum. Relief air is to be ducted directly to the outdoors rather than being discharged into a mechanical equipment room or other interior space. It is acknowledged that there may be advantage in some cases to discharging relief air into an equipment room. In such cases approval of *F&S Engineering* is required.

Relief/Exhaust Louvers: Requirements for intake louvers as listed above in the paragraph entitled *Intake Louvers* is to be applied to relief air and exhaust air louvers with the exception of the stated velocity limitations.

ASHRAE Handbook: *HVAC Applications - Building Air Intake and Exhaust Design* serves as a noteworthy reference for the paragraphs above addressing air intake and exhaust design.

Ductwork: The importance of optimized duct design is cannot be overstated yet is often overlooked. Ductwork is more than just getting air from point A to point B in an acceptable manner. The impact of duct air pressure loss and resultant fan energy consumption can be huge. Engineers often work hard to minimize pressure drop within air handling equipment and then ignore the impact of duct pressure drop. Reducing distributed duct pressure drop and associated noise generation by upsizing ducts is helpful but installation of proper fittings is typically even more critical. Sudden expansions and contractions at duct-to-plenum connections are common violations of good design. Expanded area or oversized bell-mouth connections are to be consistently utilized. Applicable *SMACNA* standards are to be applied. In order to ensure proper installation, ductwork must be clearly laid out and drawn to scale on project drawings. Adequate coordination with other systems is to be provided and focused oversight must be provided during construction to ensure compliance. Exterior supply and return ductwork is to generally be kept to a minimum and be limited to that directly connected to roof top air handling equipment. Exterior ductwork is to be round with the exception of plenums and transitions. Exterior duct insulation is to comply with *Section 23 07 13 – Duct Insulation.* Lagging in particular must be skillfully installed to prevent eventual ingress of water into the insulation system. This is of particular concern based upon negative past experience with saturated fibrous exterior insulation systems. Uninsulated exterior ductwork (e.g. exhaust ductwork) is to be stainless steel construction.

Duct Leakage: Duct leakage tests will be performed on 100% of medium pressure ductwork rather than 25% as required by *ASHRAE Standard 90.1*. For low pressure ductwork testing a representative 25% is acceptable. Metal ductwork is to be SMACNA Seal Class A with joints, seams and wall penetrations sealed. Rectangular ductwork is to be SMACNA Leakage Class 6 and round metal ductwork is to be Leakage Class 3. Rectangular ductwork is to have Pittsburg type longitudinal seams to maintain seam integrity. Snaplock seams are not allowed.

Supply Air Velocity: For the purposes of this writing, a low pressure air distribution system is defined as a system with duct static pressure less than or equal to 2" w.c. A medium pressure air distribution system is defined as a system with duct static pressure of greater than 2" and less than or equal to 6" w.c. Air velocities within low pressure supply ducts including those located downstream of variable air volume air terminal units and constant volume boxes may not exceed 1,200 FPM. Branch run-outs to individual grilles and diffusers must not exceed 600 FPM. Air velocity within medium pressure supply ducts is not to exceed 2,400 FPM.

Fibrous Lining: Fibrous lining is not to be installed within an air handling or air distribution system with the following exceptions:

- Within room-to-room and room-to-plenum return air transfer "boots".
- Within other ductwork and system components (e.g. air handling units, attenuators, air terminal units, etc.) where the fibrous material is completely sealed within a Tedlar or Mylar

membrane and is separated from the air stream by a perforated metal barrier.

Additional conditional exception:

- With written permission from *F&S Engineering*, fibrous lining may be provided within limited lengths of readily accessible sections of supply air ductwork downstream of air terminal units given that the lining incorporates a protective coating (e.g. neoprene) and is carefully sealed at joints to prevent any erosion of fibers. This exception will only be considered for systems serving non-standard spaces with very low allowable sound levels where adequate sound attenuation cannot be achieved by application of standard noise control measures. Such applications are rare.

Flex Duct: The use of flexible duct is to be limited to low pressure duct systems. Within these systems it is to be limited to final connections to diffusers and grilles. Flex duct is not to be used in medium pressure duct systems (e.g. inlet connections to air terminal units). Each segment of flex duct is limited to 6' maximum length. Flex duct must be supported by pre-manufactured devices designed specifically for this purpose. The use of wire, tie wraps, duct tape or fabric is not allowed. Where a change in orientation from horizontal to vertical is required (e.g. at a final connection to a diffuser or grille) a metal elbow is to be used. In lieu of a metal elbow flex duct may be used to "turn the corner" if a support saddle is provided to prevent kinking. The support saddle is to be pre-manufactured. Flex duct is to be high quality (e.g. MK Plastics).

Variable air volume air terminal units (i.e. VAV Boxes): Variable air volume air terminal units are to be fitted with reheat coils. They are not to be lined with fibrous material. They are either to be double wall construction or single wall construction with fiber-free liner. Airflow measuring sensors are to be metallic construction to prevent potential of over-heat failure as has been experienced by the University multiple times in previous years. Sensors are to be configured in a grid pattern and are not to be linear probes.

Air Terminal Devices: The use of sidewall supply grilles is to be avoided where possible. They are notorious for causing uncomfortable drafts. Properly sized and located ceiling diffusers are preferred. Supply air diffusers are to be carefully selected to prevent "dumping" of cold air at minimum flow conditions. The use of high performance diffusers is to be standard practice. Supply diffusers and grilles are to be selected and installed so as to direct a greater percentage of the supply airflow toward the source of the heating/cooling load (e.g. toward exterior walls). In exterior spaces where no perimeter heating unit(s) have been provided, slot diffusers (or equivalent) are to be provided near the exterior wall(s) to deliver supply air downward at high velocity to "reach the floor" with warm supply air in the heating mode. Diffusers associated with displacement ventilation systems are to be perforated type specifically designed for application. For special requirements for terminal devices in laboratory applications reference *Laboratory Ventilation* section within these *General Guidelines.*

Supply Plenums: Ceiling supply plenums are not allowed other than in clean rooms and similar research applications. In such cases they are to be carefully cleaned, sealed and leak tested. Floor supply plenums are approved when used in conjunction with a displacement ventilation system. Similarly, they are to be thoroughly cleaned, sealed and leak tested.

Ducted vs. Plenum Return: In general, it is preferred that air from ventilated spaces be returned to associated air handling equipment via ductwork rather than through ceiling plenum(s). The use of return air ductwork has the advantage of maintaining better return air cleanliness, being easier to balance and allowing the use of standard products above ceilings rather than plenum rated products. The use of ductwork also ensures that return air passageways do not become obstructed as a result of installation of other systems (e.g. supply ductwork, sprinkler piping, electrical conduit, cable tray, etc.) However, it is acknowledged that project budget may not support this approach. Thus, the use of ceiling return air plenum(s) for offices, classrooms and similar

finished spaces is acceptable given that plenum rated cable and devices are installed, and an unobstructed return air path is provided. Achieving an unobstructed path may require a combination of ducted and plenum systems.
In any case the distance from a return duct opening to the most remote location within any associated plenum may not exceed 50 ft.

Airflow Through Passageways: The use of an exit passageway, stair, ramp or other exit as a part of a supply, return, or exhaust air system serving other areas of a building is prohibited except as permitted by the *International Building Code* and the *International Mechanical Code*. Such prohibition applies to major renovations of existing buildings as well as to new structures. Existing air distribution systems that utilize any of the exit elements of a building may not be altered in a way that reduces the level of life safety. An alteration of an existing non-compliant system must be approved by Owner. Approval will not be given to a proposed alteration unless it is clearly demonstrated that such alteration will not result in a reduction in occupant safety. Note: For the purposes of this writing, a building will be considered to undergo a major renovation if the existing air distribution system or the interior space arrangements and/or structure are modified to an extent that the renovation costs exceed 25 percent of the replacement cost of the distribution system or structure.

Makeup Air: Conditioned makeup air is to be delivered in a deliberate manner into each space from which air is exhausted. The makeup airflow rate is to be approximately equal to the exhaust airflow rate. For lab applications airflow rates are to be accurately monitored and controlled.

Toilet Exhaust: Multiple toilet rooms may be served by a common exhaust system. Janitor rooms are typically served by the same system. When zoning such systems, consideration must be given to coordinating exhaust zones with air supply zones. This approach allows supply and exhaust systems serving a common area to be cycled on and off together. Exhaust air from toilets must be discharged in an appropriate manner at roof level to minimize potential for recirculation back into air intake opening(s).

Airflow Monitoring Stations: The successful installation of accurate and reliable duct-mounted airflow monitoring stations has proven to be difficult and challenging. They are rarely installed properly resulting in compromised accuracy. In order to ensure proper installation, airflow monitoring stations and associated ductwork must be clearly laid out and drawn to scale on project drawings. Adequate coordination is to be provided and focused oversight is to be provided during construction to ensure compliance. During operation, airflow monitoring stations become dirty quickly resulting in further compromised accuracy as time passes. They must be cleaned and recalibrated on a regular basis in order to maintain accuracy and repeatability. Thus, airflow monitoring stations will be used only as required to satisfy applicable codes and standards. It is acknowledged that they may also be required to accomplish optimized control strategies when other viable options do not exist. Typically, pressure feedback control is to be used in lieu of airflow monitoring stations to provide control of building pressurization. When possible, demand control of ventilation using CO2 feedback may be used in lieu of quantitative airflow monitoring to ensure minimum ventilation air requirements are satisfied. Monitoring stations are to be protected from fouling by location in filtered airstreams if possible.