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News to Use
Design Requirements Manual
The formulae $\frac{\partial \rho U_i}{\partial t} + \frac{\partial}{\partial x_j}(\rho U_j U_i) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j}\left(\mu\left(\frac{\partial U_i}{\partial x_j}\right)\right) + g_i(\rho - \rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho \overline{U_i U_j}) = -\frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j} - \rho\overline{u_i u_j}\right) + g_i(\rho - \rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho U_i H) = \frac{\partial}{\partial x_i}\left(\lambda\frac{\partial T}{\partial x_i} - \rho\overline{u_i H}\right)$ biomedical research facilities.

'Design Requirements Manual (DRM) News to Use' is a monthly ORF publication featuring salient technical information that should be applied to the design of NIH biomedical research laboratories and animal facilities. NIH Project Officers, A/E's and other consultants to the NIH, who develop intramural, extramural and American Recovery and Reinvestment Act (ARRA) projects will benefit from 'News to Use'.
Please address questions or comments to: ms252u@nih.gov

Building Automation Systems – Part I Common Lab Room Requirements

Laboratories are designed with BAS systems to provide both temperature and pressurization control. If the laboratory is used for toxic chemicals and fumes, the laboratory HVAC system should provide negative pressurization to prohibit chemicals from migrating to other areas; if the laboratory is used for clean room applications, the laboratory HVAC system should provide positive pressurization to prevent contaminants from being drawn into the room. In any case, opening and closing of the doors shall not be impacted by airflow control. Individual laboratory humidity control is optional and shall only be done where required.

Generally, each lab zone shall have pressure independent terminal boxes on supply and exhaust, so that a volumetric flow rate set point of supply and exhaust into and out of the laboratory shall be automatically maintained regardless of fluctuations in static pressure. The pressure independent terminal box control damper is controlled to achieve a set point flow rate. The set point flow rate will be automatically varied between a minimum and maximum as necessary to meet the airflow demand of the room.

Laboratories shall have pressure or directional airflow controlled zones. On existing constant volume systems where installation of pressure independent terminals is not practical, and only with permission of the Project Officer, laboratory pressurization may be accomplished by balancing.

For Variable Airflow Volume (VAV) systems, laboratory zones shall be actively controlled by "flow tracking", i.e. maintaining an offset between the total supply and exhaust flow to the room. On zones that are required to be negative, the supply flow shall track the exhaust flow. On zones required to be positive, the exhaust shall track the supply.

If airflow is not being sensed directly, as in the application of a metering venturi valve, where the flow is being inferred from valve position, a pressure sensor shall be provided on both supply and exhaust systems that alarms when air pressure across the valve is not great enough to maintain the valve in appropriate range. For non-containment systems, if the lead system is in alarm for 2 minutes (enough time for an initial attempt at resetting set points) the system shall be put into a "Distress Mode" such that all pressure zone control set points are reduced to redistribute the lack of capacity in a prioritized fashion. Distress mode shall be alarmed and manually reset.

When less than 100% redundancy is provided in either a failure mode or an emergency power mode, and the pressure is controlled at the zone level, prioritized reset of the terminal flow set points is required to maintain the required room pressurization. The A/E shall dictate the priorities. Controls for laboratories shall be fed from emergency power.

Monitoring of space pressure with local indication is only required when the potential threat to human wellbeing or the research program from airborne contamination is significant and is required by the BMBL for BSL3 and ABSL3 facilities. This shall be discussed with the Project Officer, DOHS and the researcher to establish this need.

When the laboratory contains VAV fume hoods, the Controls Contractor shall integrate the fume hood controller with the room temperature and airflow controller. In this case, BAS controls the room pressurization and temperature requires pressure independent terminal boxes on the fume hood exhaust, general exhaust and the supply air.

The control strategy below describes these needs:
Room temperature shall be maintained by increasing the total zone exhaust airflow set point on a rise in temperature and by decreasing its set point on a fall in temperature (the minimum zone flow set point shall be limited to that required for air exchange). Room temperature shall also be maintained by modulating the reheat coil to maintain the heating set point.

Room pressurization shall be maintained by varying the supply airflow set point to track the total zone exhaust air being measured (hood flow plus general exhaust as applicable). Exhaust air through the fume hood shall be modulated to maintain an airflow that is required to maintain a face velocity set point, which is determined by the sash position. Fume hood controller shall maintain accurate control of average face velocity as fume hood sash is raised or lowered, or moved horizontally. Fume hood airflow controller shall calculate average face velocity from measured exhaust airflow and hood open face area. This face velocity is then compared to the set point to calculate required exhaust flow. The general exhaust airflow set point shall vary to maintain the total zone exhaust flow when the hood flow is less than that required for the cooling loop. All box dampers shall modulate to maintain the established flow set point.

A fume hood monitor shall be provided to receive the sash sensor output and an exhaust airflow control signal for the appropriate airflow control device. All fumes hoods require a local audible and visual alarm device, capable of detecting a drop or rise in airflow.

This application can be adapted for multiple supply or exhaust flow scenarios, or multiple fume hood sash panels.

In the VAV fume hood laboratory, the controller, terminal and all devices shall be laboratory grade that can act with the speed of response required to meet the requirements of the NIH fume hood testing protocol. This will require fast acting actuators and require fast responding controllers commensurate with laboratory grade control systems, as the speed of the supply and exhaust dampers directly affects temporary losses of pressurization. Conventional VAV terminals may be used for supply and general exhaust provided they are fitted with fast acting actuators.

Lab BAS manufacturer shall set up airflows in cooperation with TAB contractor. System startup and commissioning test shall be provided by factory authorized representatives. Please refer to NIH Specification Sections 15991 and 15992 for the details of the fume hood testing procedures.

Next month's article will discuss BAS requirements on BSL3 and ABSL3.

Further details on this month's topic are available on the DRM website
http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/DesignRequirementsManualPDF.htm
DRM Chapter 7, Section 7-3-D