

The formulae $\frac{\partial \rho U_i}{\partial x} + \frac{\partial}{\partial x_j} (\rho U_j U_i) - \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} \right) + g_i (\rho - \rho_s)$ for building $\frac{\partial}{\partial x_j} (\rho U_j H) - \frac{\partial P}{\partial x_i} + \frac{\partial}{\partial x_j} \left(\mu \frac{\partial U_i}{\partial x_j} - \rho u_i' u_j' \right) + g_i (\rho - \rho_s)$ state of the art $\frac{\partial}{\partial x_j} (\rho U_j H) - \frac{\partial}{\partial x_i} \left(\lambda \frac{\partial T}{\partial x_i} - \rho u_i' H' \right)$ biomedical research facilities.

Environmental Design Requirements for Mechanical and Electrical Spaces

This News to Use article is the first of several to address the question of environmental design requirements for mechanical and electrical spaces with respect to the Design Requirements Manual (DRM).

In all buildings the mechanical and electrical infrastructure is critical to every functional aspect of the building's operation. In laboratories and healthcare facilities the mechanical and electrical infrastructure is critical because a loss of power or environmental control can mean the interruption of vital research or even the death of a patient. For this article mechanical is referring to both plumbing and mechanical systems. The mechanical infrastructure within a facility usually begins within mechanical rooms, and then extends into every area of the facility. Access into the electrical infrastructure is gained through rooms and vaults located along the path of the electrical feed distribution system.

In the 2016 DRM the HVAC design requirements for equipment rooms was expanded and clarified from previous versions. Subchapter 6.1.18 "HVAC Design for Equipment Rooms" changed environmental requirements for mechanical and electrical rooms from conditions based on a temperature differential from outdoor air ambient conditions to requirements based on maintaining conditions within the space to be within specific temperature ranges. The basis for determining the applicable temperature range for a particular space is the equipment to be housed within the space. These temperature ranges have been defined to protect the equipment located in the spaces, and also to provide a minimum workable environment for those whose responsibility it is to maintain the equipment on a day to day basis.

The modern mechanical and electrical equipment room house a variety of equipment with variable needs for environmental conditions. Mechanical rooms can house heat generating equipment such as steam pressure reducing stations and steam to water heat exchangers, as well as heat sensitive equipment such as Reverse Osmosis systems with programmable logic controllers (PLCs). Likewise electrical rooms can house heat producing transformers and sensitive control panels for lighting or environmental systems. To make it even more complex electrical and mechanical equipment may be co-located within the same space, making determination of the requirements more of a challenge.

Below are some recommended steps the design professional should take to determine the design requirements for a mechanical or electrical space:

- Clearly define, and understand the requirements for, all equipment to be located in the space as early in the project design as possible.

Quite often heat producing and sensitive equipment become co-located because their location is not determined early in design, or left to a contractor to locate equipment during the construction phase of the project.

- Determine if sensitive equipment such as vacuum pumps and electrical control equipment can be located in a dedicated space where specific conditioning can be provided without having to account for large heat generating loads like transformers and steam condensate pumps.
- As much as possible locate equipment spaces that have higher temperature requirements to locations where natural ventilation is readily accessible.
- Confirm all code ventilation requirements for the space. Storage of cylinders or other products within the space may change the ventilation requirements to meet other codes such as NFPA 55 or NFPA 68.
- Many designs at NIH involve renovation of existing facilities. For these designs it is critical for the design team to have a complete understanding of the existing HVAC infrastructure in and around the area of renovation. Knowing what capacities are available, even beyond the floor plan of the specific renovation, can sometimes provide resolution to the design requirements.

Once all of the above information is collected and initial layouts determined, the designer can start to define the spaces based on the breakdowns within the DRM for Equipment Room HVAC design. The intent of the DRM is to design a system that is as reliant on outdoor air ventilation as possible to reduce energy costs for predominantly unoccupied spaces. Supplemental heating and cooling systems can then be designed to maintain the space within the temperature requirements of the DRM.

Where specific conditions are found where requirements of the DRM cannot be met, the condition should immediately be brought to the attention of the Project Officer. The issues can then be addressed with Division of Technical Resources through the Variance process as found in Chapter 1 and Appendix K of the DRM. As can be seen, early identification of issues is critical for maintenance of project schedule and determination of the most efficient resolution.

In upcoming News to Use articles we will be addressing specific aspects of HVAC design for mechanical spaces and electrical rooms, based on questions that have been received since the issuance of the 2016 DRM.

'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:** shawm@mail.nih.gov

Further details on this month's topic are available on the DRM website DRM Chapter 6, Section 1

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