Division of Technical Resources
Office of Research Facilities
The National Institutes of Health
Vol. 01, No. 63
June 2015
News to Use
Design Requirements Manual
The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U_j U_i)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\overline{U_i}\overline{U_j})=-\frac{\partial \overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U_i}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial \overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ 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: shawm@mail.nih.gov

Operable Windows

The potential benefits and increased use of operable windows in institutional buildings has raised questions regarding the Design Requirements Manual (DRM) prohibition of their use in laboratories and animal research facilities. The purpose of this article is to provide a brief overview of the issue and to provide rationale for the prohibition.

In recent years operable windows have become increasingly common in many types of buildings, including a number of prominent high-performance buildings. Operable windows have a number of benefits and their use in office and other non-research space should be assessed in consideration with the building's geographic location, function, budget, sustainability goals and other factors. Operable windows, however, are functionally incompatible with NIH laboratories and animal facilities.

Benefits and Advantages

Operable windows provide natural ventilation which has a number of potential benefits, including:

Reduced utility costs. Natural ventilation allows the introduction of warm and cool air to the interior of building during favorable outside temperature and humidity conditions.

Increased occupant comfort. Natural ventilation provides air movement which, at moderate velocities, make a space comfortable under a wider temperature range than still air.

Psychological benefits. Many people prefer 'fresh' air and the auditory and olfactory connection with the outside environment. Many people also prefer to be able to control their environment by being able to open or close windows.

Air quality. Outside air has less CO2, VOCs and other undesirable contaminants associated with product outgassing in addition to the contribution of the occupant load.

Incompatibility with Research Space

Despite the advantages, natural ventilation causes a number of conditions which are incompatible with the function of research laboratories and animal facilities. These facilities operate under highly controlled environmental parameters which cannot be maintained with operable windows, thus the prohibition in the DRM.

These include:

Temperature and humidity control. Research facilities are designed to operate within a limited temperature and humidity range due to the sensitive nature of the processes performed and the equipment used. Operable windows can cause temperature and humidity swings in excess of those experienced by a space with fixed windows. High humidity can cause condensation. Temperature and humidity variations can negatively impact precision equipment.

Air movement. Unpredictable air movement around fume hoods, biological safety cabinets and similar devices can negatively impact their performance compromising the safety of personnel.

Pressurization and containment. Laboratories are generally negatively pressurized relative to corridors and public spaces to control potential airborne hazards and provide containment. Operable windows create fluctuating air pressure, making control and containment virtually impossible.

Other Factors to Consider

In addition to building type and function, geographic location is a key determinant to the practicality of operable windows. In most geographic regions the climate requires that a building utilizes operable windows for a portion of the year, and mechanical heating and cooling the rest. The climatic design data found in ASHRAE Fundamentals, unique for each city, provides information that can assist in determining the number of days that operable windows can be comfortably used, considering historic temperature and humidity data. Other considerations include topography, prevalence of storms, high pollen and particulates and other factors that could limit usage. The benefits of operable windows have to be weighed against the costs and the number of days that they will be used.

Other factors to consider are:

Cost. Operable windows have a higher first cost than non-operable windows.

Air quality. HVAC systems typically include filters, which reduce the particulates in the air. Without this higher levels of pollen, dust and other contaminants can enter and accumulate inside the building.

Increased HVAC system burden. If windows are inadvertently left open, the building HVAC systems can experience an unduly high heating or cooling loads and higher relative humidity which the HVAC system is required to control.

Conclusion

Operable windows have a number of benefits in office and other non-research space, and their use in a particular project should be assessed relative to a number of factors, including geography; sustainability goals and budget. Operable windows, however, create uncontrolled interior environments, including temperature, humidity and pressurization fluctuations, which makes their use incompatible with laboratories and animal research buildings.

Further details on this month's topic are available on the DRM website:
Design Requirements Manual
DRM Chapter 4 Section 4 Exterior Architectural Elements