The National Institutes of Health | Division of Technical Resources | Office of Research Facilities

Design Requirements Manual **News to Use**

October 2023

Vol. 02, No. 74

The formulae $\frac{\partial \rho U_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho U U_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ *for building* $\frac{\partial}{\partial x_j}(\rho\overline{U_i}\overline{U_j})=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ *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 for Maintainability

Designing for maintainability requires providing adequate space and accommodation for mechanical systems and lab equipment for ease of maintenance and to keep valuable NIH assets in proper operational condition. Good maintainability in design emphasizes the integration of design and construction knowledge with operations and maintenance (O&M) needs in collaboration with the architect, engineer, owner, maintenance staff, and other stakeholders.

General Design Considerations

Major mechanical, plumbing, and electrical equipment is typically located in indoor mechanical, electrical, and plumbing (MEP) spaces. Proper layout allows access to all serviceable current and future equipment in mechanical and electrical rooms and associated interstitial spaces. Designers must include adequate clearance and provisions for routine maintenance and the removal or replacement of equipment and components, including HVAC coils, large fan motors and pumps, and heat exchangers. Including the required clearances on the drawings helps to preserve them through construction. The equipment must be visible in addition to accessible to facilitate inspection, which is critical to maintainability. Hazardous exhaust fans may be located on the roof to minimize risk to maintenance staff.

Designers shall consider access to components such as valves, actuators, dampers, and junction boxes. For critical applications, valves, dampers, and terminal units are located in interstitials, mechanical penthouses, or mechanical spaces. This provides maintenance staff easy access to equipment and devices for calibration and without impacting lab operations or the need for maintenance staff to enter containment or clean barriers.

Interstitials, penthouses, and utility rooms require elevator access, adequately tall and wide aisles and walkways, and unobstructed paths for carts, among other things. Most roofs require stair access.

Small mechanical equipment, such as fan coil units, must not be located above sensitive equipment like microscopes. No equipment should be located in confined spaces. Designers must make every effort to avoid installing utilities like piping above critical and sensitive areas, including electrical rooms, imaging rooms, and cleanrooms.

Equipment must be labeled, and nameplates must be visible and accessible. Pipes and ducts must be identified and include flow direction. Service isolation valves should be provided at critical locations to allow for easy isolation in case of an emergency.

Zoning Considerations

HVAC, electrical, fire control, and plumbing systems are zoned to avoid the overlap of multiple systems over various building zones. Zoned systems include piping, ductwork, conduits, cable trays, sprinklers, lighting, terminal units, and diffusers. Zoning also enables partial facility shutdown. Designers should ensure their construction documents identify zone boundaries.

Equipment Redundancy

Equipment and component redundancy is an essential element of NIH facility design. *DRM* 1.15.3.R requires no less than N+1 (parallel) redundancy for primary system equipment and devices that require frequent maintenance or whose failure would result in substantial loss of building operations or research capacity. This redundancy allows for enhanced maintenance, as equipment may be isolated for service without impacting the program. Redundancy also results in improved reliability and continued functionality if a piece of equipment fails, since the remaining equipment in the system will be capable of fully supporting the functional requirements.

Indoor Design Conditions

Designers must ensure equipment rooms maintain adequate indoor temperature, humidity, and ventilation. *DRM* 6.1.18 provides minimum indoor design conditions for mechanical and electrical rooms as well as for sensitive equipment. In general, mechanical rooms shall be designed between 18° C (65° F) and 31° C (90° F).

Drainage Provisions

Walking surfaces and areas for servicing equipment should be free of slippery substances and standing water. Floor drains should be located such that liquids do not flow into traffic areas. Mechanical rooms located above occupied areas must be provided with adequate curbs around floor penetrations and leak detectors. All floor penetrations must be sealed and designed to maintain strength and load ratings at the penetration as well as where condensation is a concern. In addition, the floor penetrations must maintain water-tight characteristics.

Conclusion

Addressing the importance of maintainability early in the design process and consistently applying maintainability design principles ensures equipment will be properly serviced and operational when needed.

'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/Es 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:** mario.orellana@nih.gov

Further details on this month's topic are available on the DRM website DRM Chapter 6, Section 6.1.2, .8, 18. 19, 22, Heating, Ventilation and Air Conditioning: https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016