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

Design Requirements Manual **News to Use**

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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 $\frac{\partial}{\partial x_j}(\rho\overline{U}\overline{U_j})=-\frac{\partial\overline{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial\overline{U_i}}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\overline{U}\overline{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial\overline{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Research Laboratory – Planning Fundamentals

Before executing the design of a research laboratory project, whether it's new construction or a major renovation, it's recommended that certain activities are conducted during what is commonly called predesign. The predesign phase, which consists of both programming and planning, helps to identify and document factors that impact the project and that the design will meet the objectives of the end user. With regard to research laboratories, this includes a wide range of parameters such as the type of research, projected staffing, space requirements, existing conditions, budget, energy, life-cycle costs and considerations for future growth. The 2016 edition of the NIH Design Requirements Manual provides updated details and requirements associated with Planning and Programming in Chapter 2. Outlined below are some key planning fundamentals that should be considered during the predesign phase for research laboratories.

Identification of Stakeholders:

The NIH requires an integrated planning and design process that seeks the active and continuing participation of all stakeholders who are affected by the project from planning through activation and operation of the facility. Active participants include those involved in the development of the program and project plan. Examples of some common types of stakeholders include those with executive oversight of a Program such as the Scientific Director; end users such as Principal Investigators, their delegates, and technical staff; the architect/engineer; administrative personnel, facility manager and those with oversight over security, safety and information technology.

Project Program:

A research laboratory project includes a definition of the program for the facility, stating requirements that include organizational and design concepts, facts, goals, and space needs. A laboratory project program requires an understanding of the general processes and specialized functions to be conducted within a research lab. Different fields of research have varying demands for bench configuration, containment devices, lab utilities, support space, equipment density, safety and other criteria. Development of the project program with identified project parameters and the data collected help ensure the process, needs and requirements of the research laboratory have been understood, documented and recorded.

Laboratory Planning:

The laboratory planning process utilizes program data obtained to develop well organized, coordinated spatial concepts that successfully address user goals, functional needs, project parameters and design requirements. Adequate space should be provided to accommodate clearance requirements and laboratory components including chemical fume hoods and/or biological safety cabinets (BSC's), laboratory benches, equipment storage, and desk space. Below is a brief list of items that should be considered while engaged in laboratory planning.

1. **Determining Staffing and Space Requirements:** Each laboratory has unique program characteristics to support the number of research staff and the science behind it. The actual occupancy of each laboratory should be determined before moving towards design.
2. **Functional Relationships:** Laboratory facilities are typically organized into two basic zones: a personnel zone and a laboratory zone. The organization of the laboratory facility will be determined by the structure and operation of the program as well as practical, safety and ergonomic factors.
3. **Workplace Enhancements:** Some laboratory personnel spend a great amount of time in the lab, therefore research laboratory design should promote physical and psychological well-being and look to achieve high aesthetic, ergonomic and safety standards. This includes incorporating natural lighting, creating areas of interaction and collaboration, and increasing safety measures separating the workstation from the lab for lab personnel.
4. **Flexibility:** Designing a research lab that allows for flexibility and adaptability ensures that a laboratory can meet evolving research needs, functional changes and accommodate changing technologies in conducting scientific procedures. Examples of planning concepts surrounding flexible design include modular design, open laboratory design, careful consideration of select laboratory furnishings, and the selection of utility systems.
5. **Occupational Health and Safety Considerations:** Identifying, evaluating and mitigating potential hazards (Risk Assessment) within a laboratory environment is another essential planning element. The risk assessment process considers both biological agent and laboratory procedure hazards to determine the appropriate Biosafety Level (BSL) as well as other precautions. BSL criteria address standard microbiological practices, special practices, safety equipment, HVAC and pressure differentials, and laboratory facility design. All laboratories designed for the NIH shall be designed to BSL-2 as a minimum standard in accordance with the latest edition of the *Biosafety in Microbiological and Biomedical Laboratories (BMBL)*. Risk assessments are crucial for identifying the risks that are inherent with working with biological material and developing the appropriate safeguards.

The information provided here are just a few fundamental guidelines that should be considered during the predesign phase. Identifying the objective, goals, budget, and defining the program of requirements all contribute to helping ensure the success of the project. For more details and information as to the how the NIH establishes requirements on Planning and Programming for research facilities, please refer to Chapter 2 of the 2016 edition of the NIH Design Requirements Manual.

'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
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016.aspx
DRM Chapter 2, Section 2.1