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Design Requirements Manual **News to Use**

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The formulae $\frac{\partial \rho \bar{U}_i}{\partial t}+\frac{\partial}{\partial x_j}(\rho \bar{U}\bar{U}_i)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \bar{U}_i}{\partial x_j}\right)+g_i(\rho-\rho_0)$ for building $\frac{\partial}{\partial x_j}(\rho\bar{U}\bar{U}_j)=-\frac{\partial \bar{P}}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \bar{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho\bar{U}\bar{H})=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial \bar{T}}{\partial x_i}-\rho\overline{u_i'h'}\right)$ biomedical research facilities.

Light Gauge Steel Wall Framing

Most non-loadbearing interior walls are framed with light gauge steel framing. DRM sections 4.3.1.1 and 4.3.2.1 provide minimum gauges for steel framing for office and laboratory walls at 22 and 18 gauge respectively. As noted in the commentary, these are minimums, and not to be used in all conditions. Due to the widely variable uses, configurations and performance requirements of laboratory facilities it is incumbent on the designer to determine the appropriate gauge and detailing for each application.

Performance Considerations

Interior framing serves many purposes besides holding up wall finishes, including:

Acoustics. Acoustic performance is essential for many functions, including offices and conference rooms, patient confidentiality, and vivariums. Related to acoustic performance is the transmission of vibration which is important with sensitive equipment and animals. The DRM sets minimum Sound Transmission Class (STC) ratings for wall assemblies of 50 for functionally separate areas and 60 for animal holding rooms. These values are minimums which should be assessed relative to the facility's function and may have to be exceeded to address specific program requirements. The gauge, spacing and detailing of the framing may have to be modified to meet the required STC rating.

Containment. For many types of labs the wall finish system constitutes the containment barrier. The integrity of the finish system, which can be a high performance coating or an applied panelized material like fiberglass reinforced plastic (FRP), is dependent on the integrity of the underlying wall system. A wall which moves or deflects can transmit that movement into the finish system, which can result in cracks or open seams and loss of containment. A maximum acceptable wall deflection should be determined and the wall framing designed accordingly.

Support of Shelving, cabinetry and equipment. The DRM specifies that laboratory shelving be designed for a capacity of 50 lb. per linear foot for a 12" deep shelf, and proportionally greater for deeper shelves. For a wall with tiers of deep shelving that could translate into hundreds of pounds of load per linear foot of wall. Wall framing must be detailed to support the maximum design wall loading, including asymmetrical lateral loading. In Addition to shelving, equipment which may be heavy, vibrating or sensitive may also have to be supported. Strapping must be provided as specified in DRM 4.3.1.2B.

Pressurization. All labs are required to be pressurized relative to the corridor, and some labs have cascading pressure between rooms that can result in substantial relative pressure differentials. Walls must be designed to withstand pressure without excessive deflection or cracking of finishes. During failure-scenario testing the pressure may increase substantially beyond the design steady-state conditions.

Shielding. Some laboratory walls incorporate electromagnetic, x-ray or other types of shielding. Shielding can be on the surface of the wall or incorporated into the structure of the wall. Shielding consultants will advise whether frame walls are appropriate and how they must be detailed.

Utilities. The designer needs to have a full awareness of the utilities located within a wall. Utilities such as piping and conduit may be less than 3 5/8" in size, but require a greater depth due to supports or connectors.

Fire Ratings. In addition to other requirements, walls required to be fire rated must be designed to the criteria of a UL design for the appropriate rating.

To perform as required the components and detailing of a steel frame wall must be carefully selected. One basic consideration is whether the studs can end above the finished ceiling or whether they must extend to the structure above. Fire ratings, STC rating, load capacity and deflection must all be considered.

Stud Design. A major factor in stud design is deflection. In most cases deflection should be limited to L/240, but less deflection may be required to maintain finish integrity. A number of gypsum board and steel framing manufacturers provide deflection tables for studs, but these do not account for the loading and performance requirements of laboratory buildings.

The performance of steel wall framing can be increased in a number of ways, including:

Increase stud depth. Although 3 5/8" is the minimum DRM-allowable depth for standard walls, studs are available in a range of depths of 6" and greater.

Decrease stud spacing. Although 16" is the minimum DRM-allowed spacing, studs can be spaced at 12".

Increase stud gauge. Stud gauge can be increased beyond the minimum 18 and 22 gauges.

Stiffener channels. Wall stiffness can be increased by installing stiffener channels through the steel stud knockouts or otherwise reinforcing the studs.

Summary

The performance needs of laboratory wall framing systems should be determined and documented as a project requirement. Framing should be designed to address these requirements, not solely based on DRM minimums or standard deflection tables.

'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@nih.gov

Further details on this month's topic are available on the DRM website DRM Chapter 4 Architectural Design
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016