Division of Technical Resources
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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 $\frac{\partial}{\partial x_j}(\rho\overline{U_i U_j})=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial U_i}{\partial x_j}-\rho\overline{u_i u_j}\right)+g_i(\rho-\rho_0)$ state of the art $\frac{\partial}{\partial x_i}(\rho U_i H)=\frac{\partial}{\partial x_i}\left(\lambda\frac{\partial T}{\partial x_i}-\rho\overline{u_i h}\right)$ 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: ms252u@nih.gov

Ceiling Options in Vivariums

Ceilings, like all other vivarium assemblies, have stringent performance requirements. The Guide for the Care and Use of Laboratory Animals requires that ceilings be *"…smooth, moisture resistant, non-absorbent and resistant to damage from impacts"* and *"…free of cracks, unsealed utility penetrations and imperfect junctions"*. The National Institutes of Health's Design Requirements Manual (DRM) requires that all laboratory finishes be *"…capable of withstanding washing with strong detergents…"*.

The performance of vivarium ceilings is crucial due to a number of factors:

1. Durability: Vivariums are subject to extreme wear and tear. Depending on the location, ceilings may be subject to extreme humidity, pressure washing with strong detergents and pressure differentials.
2. Cost: Vivariums are very expensive to build and to operate. Delays during construction and downtime after completion are to be avoided.
3. Criticality: Vivarium operations are critical to research programs. Ceilings failures, which may disrupt operations, are to be avoided.

Exposed-structure ceilings are generally not appropriate for vivariums, but can be used in limited applications if detailed to eliminate exposed ductwork, conduit and other items that could hinder cleaning or harbor pests. Most vivariums utilize one or a combination of suspended ceiling types. Regardless of the type of ceiling, utility systems should be carefully designed to limit the need to access above-ceiling devices within the vivarium perimeter. Suspended ceilings options include:

Acoustical Tile Ceilings

Acoustical tile ceilings offer the advantages of low cost and fast installation. Acoustical tile ceilings are also pre-finished, and provide unlimited above-ceiling access. Specialty systems are available with a number of features which are necessary for vivarium applications:

- Corrosion resistant suspension system and grids. This is necessary due to the high humidity and harsh cleaning compounds in many vivarium environments. All components, including anchors and connectors, must be of compatible, corrosion-resistant material, and designed for heavy ceiling tiles and room pressurization.
- Fiber reinforced polyester (FRP) ceiling tiles. Ceiling tiles have to be heavy-duty, moisture proof and non-sag.
- Continuous gaskets. Ceiling tiles and grid must have gaskets to provide a continuous seal. The gaskets must be compression-bulb type or otherwise appropriate for repeated re-sealing, and must be chemical and moisture resistant. Gaskets are also required at lights, mechanical devices and all other ceiling-mounted items.
- Hold-down clips: Clips are required to hold down the ceiling tiles and compress the gaskets, ensuring that items are not dislodged and the ceiling maintains its integrity.

Acoustical tile ceilings have a number of disadvantages. If not carefully installed and maintained, gaskets and clips may not maintain the integrity of the ceiling seal. Pressure-washing and other maintenance activities can dislodge and damage tiles. For these reasons, acoustical tile ceilings are often not used in cage wash rooms, holding rooms, and other rooms subject to wash-down and high humidity.

Gypsum Board Ceilings

Gypsum board ceilings provide a smooth, monolithic, sealed surface. When finished with a high-quality epoxy paint, gypsum board can provide a durable, water-resistant assembly.

The suspension system, consisting of a grid of main- and cross-members suspended from the building's structure, must be corrosion resistant and designed for room pressurization. Standard gypsum wall board is not appropriate for vivarium applications, and a moisture-resistant, non-sag, impact-resistant board must be used. The finish of the gypsum board must be compatible with and meet the specifications of the epoxy paint to be applied. The epoxy paint is key to the integrity of the ceiling assembly, so the painting contractor must confirm that all conditions are acceptable prior to paint application.

Fiberglass Reinforced Polyester (FRP) Ceilings

FRP is a polymer and fiber composite material, usually available in 4' x 8' or 4' x 10' sheets. FRP systems consist of sheets, anchorages, sealants, battens and other accessories. An assembled system provides a pre-finished, durable, water resistant ceiling.

FRP systems require a suspension system similar to gypsum board ceilings. Some FRP systems are installed directly to the suspension system, and some are adhered or fastened to a gypsum board substrate. FRP panels must be installed following manufacturer's directions, using all required accessories and materials, to achieve a complete, warranted system.

For both FRP and gypsum board ceilings access must be provided for all above-ceiling items requiring maintenance. Access panels must be sealed or gasketed stainless steel. Lights, mechanical devices and all other ceiling penetrations must be sealed, per the DRM Sealant Table, to ensure the integrity of the ceiling seal.

Further details on this month's topic are available on the DRM website
http://orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManualPDF.aspx
DRM Chapter 4, Section 4-4 Interior Finishes