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

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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* $\frac{\partial}{\partial x_j}(\rho\overline{U}_i\overline{U}_j)=-\frac{\partial P}{\partial x_i}+\frac{\partial}{\partial x_j}\left(\mu\frac{\partial \overline{U}_i}{\partial x_j}-\rho\overline{u_i'u_j'}\right)+g_i(\rho-\rho_0)$ *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.*

Laboratory Floor Drains, Floor Sinks, and Traps

NIH laboratory buildings contain numerous plumbing and piping systems necessary for basic laboratory operations, including animal functions. Floor drains and traps are two of the many elements that make up these systems. All floor drains and floor sinks shall conform with requirements of the International Plumbing Code (IPC) or Uniform Plumbing Code (UPC) and Chapters 8 and 13 of NIH Design Requirement Manual (DRM).

Design Requirements

Floor drains/sinks are required wherever water is likely to accumulate and create a hazard, where intensive wet cleaning and water spray operations are required as described in Section 8.2.26 of the DRM, and where there is risk of flooding. Wet laboratories can be prone to flooding and susceptible to damage, especially in areas where autoclaves, glass washing, and water-intensive equipment is located as well as areas below a lab with a poorly installed floor drain above. Floor drainage specifically provides three basic functions for these areas:

- Interception – Effectiveness of surface fluid removal
- Conveyance of fluids – Ability of fluid movement or transport
- Ability to act as a barrier – Interface between the waste fluids and the sewer

However, there are risks inherent to laboratory floor drains. As drain components have ample water supply and by nature receive organic matter, they build up nutrients and provide an environment to harbor microorganisms. Many studies highlight the drain as the most significant area for microorganism activity. Floor drains in laboratories may also result in inappropriate disposal of biologicals or chemical materials and spills that must be otherwise handled by a spill-response protocol. Inadvertent chemical disposal and the presence of pathogens in the drainage system, as well as risks associated with drainage backups and sewer gas, are some of the reasons to properly maintain floor drain systems. The use of electric trap primers, as stated in section 8.2.24 of the DRM, can assist with the maintenance.

Floor drain location should consider the various risks while complying with code requirements. In laboratory buildings, there are many non-laboratory areas that require floor drains, such as interstitial/mechanical rooms, kitchen areas, cage wash areas, service corridors and non-human primate (NHP) and large animal areas. However, NIH does not allow the use of floor drains in laboratory areas, as stated in section 8.2.26.2 of the DRM, or in highly controlled environments such as Tissue Culture labs and Aseptic Processing rooms (ISO 7 and ISO 8), as stated in section 13.4.2 of the DRM.

Floor drains are designed to perform as receptors of fluids from various processes; as a result, their installation requires the use of a trap seal and vent piping as shown in the Figure 1, Floor Drain-Trap Diagram.

When floor drains are subject to cleaning or accidental spills, it is not surprising that drainage components can harbor bacteria; they are prone to biofilm formation, and cleaning and disinfection of floor drains and traps does not remove all surface-borne microorganisms. Furthermore, because trap seals are normally filled with water, there is the potential for infiltration of sewer gas into the laboratory if the seals are not properly maintained. Even during cleaning, the removal of the foul air trap, which can clog if particulates are not removed, may promote circulation of the fouled air between a contaminated sewer system and the production area. These factors and their associated potential for contamination all contribute to the need for careful location of floor drains and sinks.

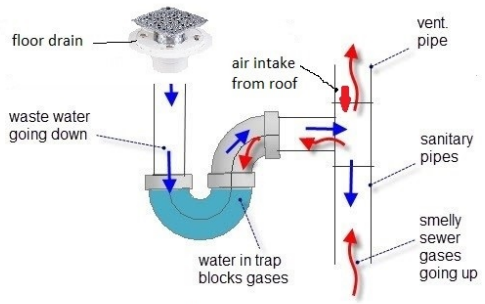

Figure 1 Floor Drain-Trap Diagram

Additional Design Requirements and Considerations

During laboratory renovation work, existing floor drains or floor sink locations must be coordinated with the laboratory design to ensure proper application of the drainage system per DRM Section 8.2.26.3 and 8.2.26.4. These sections and those referenced in the Design Requirements above will assist architects and engineers in properly designing details and specifying the types of floor drains or floor sinks appropriate for various areas of a laboratory building at NIH, per section 8.2.26.1 of the DRM.

Conclusion

Proper selection, design, and installation of suitable floor drains or floor sink assemblies, including traps, are crucial to avoid unintended flooding and ensure safe fluid waste removal while maintaining an effective barrier from sewer waste contamination. A risk assessment should be considered when locating or reusing floor drains to evaluate all possible scenarios for laboratory contamination and flooding.

Resources

1. NIH Design Requirements Manual (DRM) Revision 1.5: 03/26/2020
2. International Plumbing Code (2018)
3. Journal of Hygienic Engineering and Design, Hygienic Design and Operation of Floor Drainage Components

'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 Section 8.2 Plumbing Fixtures and Equipment
https://www.orf.od.nih.gov/PoliciesAndGuidelines/BiomedicalandAnimalResearchFacilitiesDesignPoliciesandGuidelines/Pages/DesignRequirementsManual2016