Agile Spaces

Effective design solutions for
lab and technical facilities

Mobility is a key factor for flexibility, and extends far beyond designing an expansive, open room suitable for any purpose.

Today, research facilities are moving beyond labs with benches and countertops. Labs include layouts that cater to more specific needs: fume hoods and biosafety cabinets, as well as specialty medical apparatus, such as imaging, magnetic resonance imaging, and computerized tomography equipment.

Achieving a balance is the key, and this balance is different for each institution's unique needs. If labs are too customized, the design loses flexibility and researchers aren't likely to work in the building throughout its lifecycle. So, designers and planners look to optimize capital expenditures relative to designing and building the lab for present needs and with an eye to the future.

At the same time, there are different levels of biosafety containment among labs, with requirements and protocol related to specific biosafety threat levels. Also, scientific leaders have environmental requirements for engineering regarding vibration, testing spaces, electromagnetic interference (EMI), and acoustics control, as they apply to such areas as optics labs or other specialty equipment areas.

Design response

To accommodate these shifting needs, designs are becoming more sophisticated as scientists push the limits of lab activities and equipment.

Funding sources, both corporate and private, are also a factor. At institutions such as Purdue University and the University of Notre Dame, the engineering schools might have grants for researchers that accentuate project budgets but often come with criteria that design teams need to carefully factor. Leaders and project teams are always conscious of cost, and each institution has a specific approach to labs relative to their grants and other funding sources.

External factors impact building performance. For example, specialized equipment is sensitive to factors— such as vibration or EMI—inside as well as outside the building. If the building is located adjacent to a power system or a train, these factors can influence the design of the building. Within the lab, if conduit runs through the space or an elevator is located nearby, these conditions can drive the location of special equipment and influence the specifics of the building planning.

Flexibility and resiliency

Today's technical spaces and laboratories are emerging as adaptable areas able to accommodate highly specialized functions. Such specialized spaces need to be designed with inherent flexibility, including the ability to be quickly reconfigured, even if only on a short-term basis. Flexibility applies to short-term changes, while resiliency relates to absorbing change over time in a larger context. For the longer term, the spaces must be resilient, with the capacity to make adjustments as research directions change. In addition to these conditions, each lab requires special consideration based on its intended occupancy and function.

Let's consider an example. With Notre Dame's McCourtney Hall, the project team asked whether education leaders wanted to limit chemistry to the third floor or distribute labs throughout the facility. Chemistry labs have specific exhaust requirements depending on the number and size of the hoods, impacting the size of air handlers and exhaust systems for the building. Therefore, placement planning is key. Ultimately, educational leaders made the decision not to limit where the location of the hoods could be placed—they could be located anywhere researchers wished. The design of the HVAC system— size of ductwork, air handlers, and the linear feet of fume hoods—allows for this flexibility. Addressing this issue up front made the solution much more cost effective.

Capacity can also be a challenge. Capacity indicates not only the size of the space, but also the overall fume hood capability (total linear feet frontage) in the building. Discussions about adjusting for future capacity center around the impact that the existing size of exhaust and fume hoods already has in the space. Flexibility in this area includes exhaust systems that can accommodate various configurations.

Emergency generators are another large component of capacity that receive specific consideration. Design teams conduct risk analysis to choose a generator that can protect both personal safety and research investment while providing flexibility, accommodating load, and fitting within the budget. Generators first serve life safety issues within the building (fire alarm, smoke detection, exhaust, certain lighting) and also serve capacity relative to high-priority equipment, such as freezers in which invaluable research samples are stored. Redundancy of generators is an especially important consideration, given what the generators are supporting.

With an expanding need for technical and lab space on higher education campuses, many institutions are searching for innovative ways to incorporate specialized equipment.

Special equipment

With an expanding need for technical and lab space on higher education campuses, many institutions are searching for innovative ways to incorporate specialized equipment.

The conditions surrounding special equipment require a case-by-case approach. Conditions include vibration, for instance, as well as acoustics and EMI. Maintaining environmental levels in these areas is critical to specific areas of research, but not all. Likewise, gases are used for some types of research and not others, so they can be centrally installed, or at point of use: a manifold in a closet, or what best suits the specific purposes of that building. Specialized imaging equipment can be another challenge for planning, design, and installation. There is no one-size-fits-all solution, so the key is to develop a kit-of-parts design strategy that provides flexibility and resiliency for any application.

Level of replication is also important. For example, a core area with wide access where key pieces of equipment can be shared by multiple researchers—this helps to maximize the return on investment for expensive equipment. At McCourtney Hall, a cross-disciplinary research building that was recently finished, the design accommodates future growth from both a fume hood and equipment perspective. The zoning and constraints on the building were unique because of the variety of functions and their technical nature. This was similar to other projects, but with some completely new conditions that required flexible thinking and creative design.

Innovation and insight

Mobility is a key factor for flexibility and extends far beyond designing an expansive, open room suitable for any purpose. While these spaces aspire to accommodate many uses, they are ultimately technical spaces with highly specialized equipment. One savvy approach is to split the space into several modules, with shared common areas across multiple labs. Shared systems, such as lab vac, compressed air, central nitrogen, and RO water systems, in all the lab zones make the spaces more functional and practical, while the ability to move mobile casework makes them adaptable.

Agility is another trending concept. Agile spaces lend themselves to inevitable future renovations. As grant-funding structures change and researchers move or retire, agile spaces can adapt accordingly. It is important for educational leaders to identify which components are more generic and which are more specialized or customized to a particular researcher.

A decisive combination of mobile and built-in casework provides for personal customization for researcher-specific functions in the lab. An adjacent storage area (or resource room) can store alternative equipment that can be exchanged when the lab is used for different functions or by different researchers.

Flexibility is a cost-saving measure, because the more specialized a space is, the more cost is involved for modification when research needs evolve. Leaving some "shell" spaces less furnished allows such spaces to be built out later as new researchers are hired or as part of an institutional strategy or funding model. An adaptable space can be modified to support the work of each researcher.

One of the solutions to make these spaces useful and flexible is found in the casework. If a researcher needs to quickly relocate, they can utilize mobile casework and move throughout the building. Enabling these types of short-term changes—and fast—without significant or structural modification makes the building ultra-flexible for a variety of uses.

In a biomedical engineering facility at Purdue, the design team used a combination of fixed and mobile casework in many labs, concentrating the fixed casework around sinks and hoods, where utility infrastructure was required. In other areas, mobile casework could be moved and substitutions made quickly where new equipment, shelving, or other changes occurred from one researcher to another.

This savvy, modular approach also makes it easier for researchers to move from lab to lab, ultimately enhancing collaboration.

Architects and designers are challenged to keep pace with scientific progress. Today's designs are getting more sophisticated as scientists push the limits of lab activities.

McCourtney Hall employed a combination of fixed and flexible furnishings, including capacity for hoods, so the system can accommodate additional hoods if needed, and emphasized rolling casework that could be easily re-located and plugged in for operation. This was especially useful because the building is shared between both engineering and science programs that have different needs.

A modular vac system is another innovative solution. The central lab vac system in older buildings can be applied to labs, but it can be problematic when an outage occurs or a repair is needed and everyone in the building is without it. Modular, agile vac systems are becoming more common and support future growth. They can also be inserted within zones on an as-needed basis, saving the up-front cost of a building-wide system in the project budget.

Achieving agile spaces

When project team leaders understand the goals of the research, they can best navigate recommendations and solutions for the physical environment.

Project teams aim to insightfully ask the right questions to get the required information from researchers, specific to what they are trying to achieve.

For example, a researcher wanting to push equipment beyond its maximum specification becomes a key insight to understand why they may request a higher level of vibration, cleanliness, or shielding in the room beyond the manufacturer's standard specifications. Once the goal is established, project team leaders can develop optimized, efficient means of achieving the same objective.

Project leaders optimize their ability to serve researchers by maximizing the information they can capture about the target research practices of the facility. Accommodating and understanding early in the process makes for less adjustment later. Transparent communication about the goals of the project enables the most effective strategies to respond to project conditions and constraints, thereby optimizing space and budget with agile spaces.

A combination of mobile and built-in casework provides for personal customization for researcher-specific functions in the lab.

This article originally appeared on Lab Manager, labmanager.com.

Author:

Geoffrey Lisle AIA
Principal
Email: glisle@bsalifestructures.com

ARCHITECTURE
ENGINEERING
PLANNING
INTERIORS

bsalifestructures.com
800.565.4855