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DO YOU NEED AN ENGINEERING LAB PLANNER?

This specialty consultant can be crucial to the outcome of your job

By Robert H. Sherman Jr., PE, LEED AP

Designing and constructing a successful laboratory building is not a simple endeavor. It takes a tremendous amount of effort in the programming/conceptual design phase to define the goals and requirements of the project. Without this initial planning effort, the project can easily lose focus and fail to meet the goals of the owner.

A successful project team usually has the following elements: a committed owner, a project manager on the owner's side that has experience leading complicated projects, a core group of individuals on the owner's side to help set the criteria for the new laboratory building, a dedicated team of design professionals that help transform the owner/user's criteria into a cohesive design, a construction team that is experienced in the construction of laboratory projects, and a commissioning agent to confirm that this technical project operates correctly.

During the programming/conceptual design phase, the design team typically consists of a project manager, an architectural designer, a laboratory planner, a project architect (if different from the architectural designer), and an engineering lab planner (ELP). Though ELP is a new term to many in the industry, practitioners do exist—and they are an integral part of a successful laboratory building.

The ELP plays a vital role on the design team by helping to determine the mechanical, electrical, and plumbing (MEP) criteria for each programmed space within the building. At the macro level, he or she defines the necessary central MEP systems to accomplish the goals of the owner/users. The ELP collaborates with the architectural designer, project architect, and building planning team to optimally arrange and assign the MEP space within the building. This process defines the amount of space necessary within the building to house the MEP equipment.

To set up the horizontal distribution space within the building, the ELP also works with the architectural designer and the project architect to determine the ceiling cavity of the building. The ELP utilizes the owner's design guidelines to ensure that the systems within the building conform to the requirements of the owner's maintenance and operations personnel. At the micro level, the ELP has the responsibility of communicating all of the engineering-related information that has been gathered during the programming/conceptual design phase of the project to the project's engineering team so that the final building will function as programmed.

Though an ELP plays an important role on the project, lab programming has long been viewed as an architectural responsibility, so the contributions of the engineering lab planners are often overlooked.

Who is an engineering lab planner?

The ELP can have an engineering background in mechanical, electrical, or plumbing engineering, as long as the firm has a well-rounded understanding of all three disciplines and an awareness of different structural systems. More often than not, the ELP has a background in mechanical engineering. Generally speaking, the mechanical systems, usually defined as the heating, ventilating and air conditioning (HVAC) systems of the building, are the most complicated, most expensive and most space intensive of the MEP systems. Of all the engineering trades, the mechanical design has the largest impact on the overall building design, relative to space requirements and configuration. For this reason, and for continuity and overall management of the design process, the ELP often is the lead mechanical engineer on the project.

The downloading of information from the programming phase to the design team is enhanced if the ELP is a member of the engineering team hired to design the building. However, if the engineering team is not experienced in laboratory design, many lab planning firms have at least one engineer on staff that can fill the role.

Determining program requirements

Nearly all laboratory design teams will use a series of interviews with the core group to determine the programmatic requirements of the building. Most teams will use some variation of a room criteria sheet to gather this information. The room criteria sheet is the framework for developing the design of each programmed space within the laboratory. (Typical data categories appear in the box on the next page.)

Usually, the lab planner will lead the programming sessions with the core group, which may include the initial engineering discussions. However, it is important to have the ELP follow up on those initial discussions to make certain that all of the relevant engineering requirements have been discussed and properly documented. During this process, the ELP documents the needs of the core group, and takes into consideration how those needs will affect the central systems of the building from a cost, space, and maintenance perspective.

An effective ELP will offer alternative design options to the core group when their requests are not within the feasible or financial constraints of the project. This aspect of the ELP's work effort significantly reduces the chance that major MEP system rework is necessary due to value engineering during a later phase of the project design.

During programming, the ELP will typically make recommendations regarding:

- Temperature and humidity constraints of the space.

Room data: Mechanical

- HVAC temperature (winter/summer)
- Relative humidity (winter/summer)
- Air pressure relative to adjacent spaces (positive, negative, equal)
- Thermal systems (process cooling water temperature, chilled water temperature, glycol/chilled water temperature, tank cooling amounts and temperatures, plant steam, clean steam, pure steam, tank cooling related to steam [amounts, temperatures], CIP [clean-in-place] system requirements, other)
- Supply air (filtration, ACH minimum, HEPA, Class xx conditions [cleanrooms], other)
- Exhaust air requirements (fume hoods [number, size, type], solvent cabinets [under hood or free-standing, venting details], corrosive material cabinets [under hood or free-standing, venting details], BSCs, [types, sizes, exhaust rates], laminar flow cabinets, snorkels, HEPA filtration, canopies, other)

Room data: Electrical

- Outlets (120V, 208V, 480V—including data about raceways, standby power, and number of outlets per room, and outlets per hood, as well as plug type)
- Power (dedicated circuits, UPS, special requirements, source)
- Communications (computer outlets and cable types, phones, paging, connections to equipment monitoring systems)
- Illumination (ambient light levels for offices and labs, task lights, special illumination, darkroom lights)

Room data: Plumbing

- Fixtures (eyewash, emergency shower, emergency shower drains, sinks, cup sinks in hoods, cup sinks in benches, floor drains)
- Liquid supplies (lab cold water, lab hot water, pure water with water types and daily and peak quantities noted, polishers)
- Gas supplies at hood and bench (natural gas, nitrogen, oxygen, vacuum, CA, carbon dioxide, specialty gases as needed). Note whether supplies will be house-generated or local, and the desired psig.
- Waste (neutralization, kill system)

- Type of laboratory controls.
- Configuration of fume hood sashes.
- Building filtration requirements.
- Use of central piped utility systems vs. localized systems.
- Level of purified water systems.
- Density of electrical plug load.
- Standby power requirements.
- Type of lighting.
- Extent of data distribution within the building.

In parallel with these recommendations, the ELP is formulating ideas regarding the type and size of the central building equipment, layout within the building, and utility distribution concepts for the systems. In addition to formulating the initial building systems and capacities, the ELP will also develop metrics for expansion and growth. It is reasonable to expect that the building infrastructure will be flexible/adaptable for 15 to 20 years.

Utility distribution concepts define the means by which utilities (pipes, ducts, and conduits) pass through the building. The options that are frequently considered in laboratory buildings include:

- Large chase with horizontal ductwork.
- Many small chases.
- Interstitial (between floors).
- Service corridor.

Each option has advantages and disadvantages from a planning, flexibility, maintainability, and cost perspective. The ELP helps guide the owner to the most appropriate solution for his/her project.

Engineering space requirements

Modern laboratory building efficiencies generally range from 50 to 65% of net-to-gross ft^2. If an animal facility is included, that will drop the efficiency ratio by 5 to 10%. A reasonable target efficiency for a laboratory building when all of the main mechanical and electrical systems are located within the building is 50 to 60%. That means that for every ft^2 of programmed space, an additional ft^2 is required for non-programmatic elements, such as corridors, elevators, toilet rooms, and mechanical/electrical space.

In modern laboratories, the MEP spaces usually occupy 18 to 25% of the entire building's gross square footage. That is a very significant amount of space and has cost implications well beyond the direct MEP construction cost. If the space is not configured properly, the entire building design could become unnecessarily complicated and inefficient.

The ELP is responsible for working with the project architect to understand how the MEP space breaks down into smaller components, where those components should be located within the building, and how those components should relate to the overall design of the building. It is essential that the ELP work with the project architect during the building blocking and stacking effort so that the vertical and horizontal components are arranged to allow for the most efficient engineering design possible, saving space and dollars.

Equally as important as the ft^2 allocation within the building is the clear space within the ceiling cavity. The determination of space above the ceiling is a major outcome of the initial programming phase. A delicate balance among cost, aesthetics, functionality, and maintainability must be achieved.

Design guidelines

Whether a laboratory building is being designed for a university or a government or corporate client, the owner typically has a well-established set of design guidelines. The ELP is responsible for reading, understanding, and upholding the engineering portions of these guidelines throughout design. The ELP and project architect should become familiar with the owner's design guidelines before the programming/conceptual design phase. These team members are charged with ensuring that the design guidelines make sense for the type of facility being programmed.

It is important to remember that design guidelines are frequently generated by owners based on the unique requirements of their institutions. If something within the guidelines needs to be addressed with the owner, this is the most appropriate time to make suggestions and changes. Ultimately, it is the responsibility of the ELP and project architect to make sure that the agreed-upon design guidelines are incorporated in the design of the facility.

Not an afterthought

It is common practice for the engineering lab planner to be the last person added to the team in the programming phase. Most of this early process is related to the requirements of the architectural and lab planning team members. However, there is a time during the early programming process when everybody must consider the engineering aspects of the project. During this time, it is highly desirable to retain an ELP that can relate to the users, architects, lab planners, and maintenance and operations personnel. The ELP must be familiar with:

- Functions within the laboratory.
- Functions of all of the central MEP systems.
- The process of coordinating design with the architectural team.
- The process of maintaining a building with many complicated systems.
- Developing creative solutions that work for this unique project.

Typically, the MEP systems within a building are between 35 and 45% of the total cost of construction and are the components of the building that will cause major problems if not planned and installed properly. With that much at stake, a strong ELP can make all the difference!

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