BUILDING TYPE BASICS FOR

college and university facilities
BUILDING TYPE BASICS FOR COLLEGE AND UNIVERSITY FACILITIES

Stephen A. Kliment, Series Founder and Editor

DAVID J. NEUMAN, FAIA

With chapters by DAVID NELSON; JOHN RUBLE, FAIA; GRAHAM S. WYATT, AIA; MICHAEL C. LAUBER, AIA; CHARLES M. DAVIS, FAIA; ROY V. VIKLUND, AIA; JAMES TIMBERLAKE, FAIA and STEPHEN KIERAN, FAIA; and JEAN MARIE GATH and DEBRA WATERS

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CHAPTER 3
LIBRARIES/LEARNING CENTERS

JOHN RUBLE  Moore Ruble Yudell Architects and Planners

There is no shared facility more central to the purpose of a modern college or university than its library system. Whether as a collection of print materials, or as an electronic database, or as a place of individual and group activities, the campus library provides a core of resources and services for learning and research that is vital to every discipline. Increasingly, academic libraries also serve a community of users beyond the campus, as information networks link them to a worldwide system of knowledge.

Campus libraries vary greatly in scale, program, and use, yet they all share a common set of design issues, which are outlined in this chapter. By far, the most common campus library projects are additions and remodels, and it is easy to see why: the constant evolution of electronic systems of information storage and retrieval, the introduction of new patterns of use such as group study and seminar rooms, and the on-going expansion of collections of all kinds of materials make the modern campus library a hotbed of change. Yes, of equal importance, it is a historic institution, deeply rooted in the scholarly traditions of the university, with a critical part to play in representing the cultural meaning of the campus as a place.

HISTORIC DEVELOPMENT

Our prevailing models of university or college libraries have evolved far beyond their origins in renaissance Europe alongside the libraries of monasteries and royal and private collections. The image of the renaissance monastic library, with its books stored in small alcoves, reflects both the modest size and the extreme expense of pre-Gutenberg collections, laboriously maintained by hand-copying in the nearby scriptoria.

Early university libraries were limited as well, in large part because of their rather limited scope of study in such subjects as divinity and philosophy. As an illustration of the Renaissance library, Antonella da Messina’s lovely painting St. Jerome in His Study (see color plate) reminds us of a time when the scholar might know every precious volume in the collection. It also presents for all time the moment of individual search and discovery that is at the core of every library user’s experience.

Following the invention of the printing press, libraries of all kinds grew dramatically enough to demand new systems of order and accommodation. In the seventeenth and eighteenth centuries the idea of the library as an open resource for scholarly research began to take hold. In England the establishment of the Royal Society in 1660 provided an influential model for discourse in the sciences, and the publication of its papers constituted one of the world’s first periodicals.

In Germany, the philosopher-librarian Gottfried Wilhelm Leibniz proposed the concept of a national bibliographical system of materials available to scholars of all disciplines. On such principles, the “German model” of the university as a center of wide-ranging research developed, with the library at its core. With its innov-ative scope of subject matter and well-arranged collection, Goettingen’s university library served as an outstanding example of scholarly organization and service well into the nineteenth century.
Initially, American college libraries were tiny—they collections on limited subjects often consisted in a single room—and little used. As textbooks were the primary source of information for college curricula. The first university campus to make a focal feature of its library was, significantly, Thomas Jefferson's University of Virginia.

In Jefferson's famous plan, the library occupied an honored location in the Rotunda, at the "head of the table" in his Academic Village. Modeled on the Pantheon in Rome, the Rotunda was, in effect, a temple of knowledge. By making the library the symbolic focus of his plan, rather than, say, a chapel, Jefferson affirmed the importance of scholarship over pedagogy and gave us our first point image of education in a secular society.

Later university plans followed Jefferson's lead. A well-known example in a more urban context is Columbia University in New York City. Charles F. McKim's plan of 1894 makes the library the highest building, placed at the center of a dense, formal layout.

From their humbler beginnings, American academic libraries have evolved tremendously in function, size, and importance to become major institutions that support both classic scholarship and professional curricula. Some library collections, such as that of the Harvard University Library and the combined collections of the University of California, rival any national library system in scale and quality. Individual libraries of professional schools, such as Columbia's Avery Library, have become world renowned as resources for their particular disciplines. Throughout this development, academic libraries in America have greatly benefited from the widespread use of the classification system of the Library of Congress and its published catalogs.

**PROGRAM REQUIREMENTS**

Programming is critical to the success of the library design. Programs vary considerably according to the goals of each kind of facility. Because large numbers of units (books) are involved, planning standards have evolved based on the efficient use of space and time. Comprehensive standards are available, such as Leighton and Wether's Planning Academic and Research Library Buildings (1999), which is commonly used as a guide for programming and planning and from which a number of guidelines in this chapter have been drawn. What follows is an outline of the types of space most common to library programs.

**Collection/Stacks**

Stacks, the blocks of space devoted to storing the collections, are of two types: open stacks, which are open for library users to browse, and closed stacks, which are accessible only to library staff.

Several standards for the two types may be different, depending on frequency of use, with closed stacks often having tighter circulation space between the shelves. Typically, the stacks constitute the larger single program element, almost equalling all other areas for library users and staff combined.

**Multilayer versus single tier**

Stack shelving is now most commonly single-tier, meaning that the shelves, typically of steel or wood units 3 ft wide by 7 ft 6 in. tall, are installed on each floor of the building in furniture. Multilayer stacks, found in many older facilities, are, in effect, a multistory scaffold of steel or concrete in which the floor structure is integral with the shelving construction itself. The latter approach results in a highly inflexible zone within the building, which can be difficult to upgrade in the event that building codes or shelving needs are amended. As an alternative, single-tier stacks may be designed with a lower floor-to-floor height than other program areas or doubled with a mezzanine between floors. Some well-known library designs have exploited this opportunity.

**Rules of thumb**

Library stacks range from 10 volumes per square foot of stack area including shelving and circulation, for small undergraduate facilities with open stacks only, to up to 15 volumes per square foot for major research libraries with stable closed stack areas. Annual efficiency is affected by aisle widths (about 32 to 42 in. clear), the height of stacks (rows of nominal 36 in. wide shelf units lined up side by side)

between cross aisles, and the nature of the materials being stored, which may require different depths of shelving.

In planning open stack areas, the following must be carefully considered:

- **Frequency of use**
- **The incorporation of space for carrels as well as tables**
- **Flexibility for shifting and reorganizing the collection**
- **Organization of shelving into large or contiguous areas**
- **Coordination of structural floor loads and column spacing with the shelving modules**
FIXED SHELVING

COMPACT SHELVING

- Protection of print materials from too much daylight
- Integration of open stacks with the flow of user spaces for reading and study

Compact shelving
Compact shelving is created by placing ranges of bookshelves on rails, allowing them to be rolled together, and thus eliminating all but one aisle in each structural bay. Shelves are accessed by mechanically shifting ranges, either by hand or, more commonly, with a motor assist. Compact shelving can provide more than double the storage capacity of fixed shelving for an equivalent floor area. Where structural floor loads permit, this is a common solution to increasing the capacity of existing stack spaces. Although contemporary systems have built-in safety features, compact shelving is more often used in closed stacks to store less frequently used materials.

Library Staff and Services
Library personnel provide essential services and work in three general domains:

- **Circulation desk**, which usually combines oversight of the entry area, lending, book returns and collection of fines and may, in smaller facilities, include holding and issuing reserved books.
- **Reference library and catalogs**, which includes research assistance and retrieval of paged materials from closed stacks and may include introductory classes in the use of the library's information system.
- **Support and maintenance of the collections**, which includes receiving, processing, repair and restoration, shelving materials, and copy services. Related work includes preparation and maintenance of microform materials and scanning for conversion of print to digital files.

The extent to which each set of activities is clustered, or given a discrete space, depends on the overall size and complexity of the facility. For all but the larger libraries, it is common to have staff offices adjacent to the circulation desk, as well as adjacent or close to the reference and catalog area.

Circulation desk
In most libraries the circulation desk is a multifunctional counter located near the main entry. As mentioned earlier, it allows oversight of the entry, provides general information, book check-out and return, and maintains the reserve bookshelf. Larger facilities may have separate security checkpoints as entrances, allowing the circulation desk to be more centrally located.

Reference library and catalogs
The pathways to the computers, which have largely replaced card catalogues, should move either be short and direct, as are work areas generate traffic and noise. The library at the Hax School of Business, University of California, Berkeley, designed by Moore Ruble Yudell (MRB) has them in the open, right next to the circulation desk, behind which are staff offices. Some reference/catalog workstations serve a student population of about 250. Immediately beyond the on-line workstations is the open reference area.

The reference library may be given its own space. At the Darling Law Library, University of California, Los Angeles (UCLA), also by MRB, the Reference Center and its on-line catalog are enclosed behind a glass partition, but easily reached. Here there are 24 workstations for some 1,000 student users. The enclosure allows free discussion when librarians assist students, without disturbing the nearby reading room.

Staff offices
Staff accommodations are almost always based on each campus's faculty office standards. The range of library staff needs is entirely particular to the scale and types of services. The staff of an academic or professional school library typically includes at least the following:
• Head librarian and assistant(s)
• Reference librarian and assistant(s)
• Circulation desk staff and/or staff to supervise entries, exits, and other areas
• Assistants for ordering, gifts, acquisitions, and maintenance work
• Student and/or volunteer staff
• Information technology specialist(s)

Not all library staff need be distributed, but suites offer a chance for communication and shared responsibilities. If the staff population is large enough, a break room and conference room may be important amenities.

Support and maintenance
Support areas for receiving, processing, and maintaining the collection vary greatly in size and sophistication. At a minimum, space is required for unpacking and storing newly arrived materials and preparing them for placement in the collection, including cataloging. At the opposite extreme, there may be major workshops for conservation of books and other materials, including facilities for fumigation, drying, and desiccation. These spaces' requirements for power, environmental controls, and workplace safety are not unlike those of a laboratory and must be developed with appropriate technical expertise. Receiving and shipping rooms are located in relation to overall site constraints, and security is a critical factor in how these spaces are accessed. Adjacency to service elevators, other staff, and administration is also a consideration.

Reading rooms and user work spaces
Areas for library users and for the services they require constitute a principal component of any library program and may be equal to or greater than the space needed for the collection. The overall amount of space devoted to readers is not unrelated to the size of the collection, but may be more the result of several other factors:

• The type of school and student population—a graduate or professional school library may be used more intensively than a general or college library.
• The campus location and the resident versus commuter student count, which may affect the hours and intensity of use of the library as a general study center.
• The quality or importance of the collection, which can affect intensity of use.

Capacities
Although a general library for a college may have to accommodate 25–50 percent of the student population, a law library should offer seating for most of its students and allow for significant use by visitors. A recommended approximation of overall work space per reader is 50–35 sq ft. This may be used for a variety of accommodations, including lounge seating (10–15 percent), table seating (up to 20 percent), and individual workstations or carrels (up to 85 percent). Other types of user work areas, such as group study or seminar rooms, are common, and their impact on the space needed for individual accommodations depends on the school's curriculum. Business schools can place a high priority on group projects, for example, which may affect the time and space students need for individual research.

Main reading room
The classic main reading room of a library can take a variety of architectural forms, each offering users a refuge for study. To be effective, the space should have several important characteristics:
• Adequate size, to impart a sense of being a public space
• Natural light, for ambient light and orientation
• Task lighting, to create individual workspaces within the space
• Variety of seating—tables as well as lounge seating

Carrels
Carrels are typically distributed throughout the facility's public areas, particularly adjacent to open stacks. Some 6–10 sq ft of work surface should be provided for each station, plus a small amount of shelving. Carrels that are used for more intensive research projects, assigned to
users for days or weeks at a time, should be considerably larger—a full desktop with return and additional shelf space. Carrels and other types of user workspaces, where possible, should be oriented toward natural light to control glare on computer screens. Power and data ports should be provided as virtually every seat in the library, especially at carrels.

Periodicals
Periodicals can still be conveniently located in or near a main reading room in many facilities. In some professional institutions, such as engineering schools, journals may constitute the most sought-after materials in the collection. They require greater oversight, both for security and service. Large institutions often justify housing a reading room devoted to periodicals alone. Periodical reference guides and bound back issues may or may not be close to the current issue shelving.

Although lounge seating is common and satisfactory for reading periodicals, newspapers present a different ergonomic problem. One campus created a special area by using individual café tables, which provided just enough support for large newspapers on sticks.

Twenty-four hour reading room
The hours of availability of library reading rooms are often an issue, given their importance for general study. Although some institutions may solve the problem with special staffing and scheduling, the use of an adjacent 24-hour reading room is not unusual. This space is located outside the security checkpoint and may be on a different level from the main entrance. Darling Law Library at UCLA provides this convenience, on a lower floor, with an adjacent vending area.

Special Collections, Manuscripts, and Maps
Rare book and manuscript collections are most often housed in a discrete area, with closely supervised readers’ accommodations. The materials may vary in format, including very large objects, and may be fragile enough to require special shelving and greater temperature and humidity control. Reading areas have limited access, for relatively few users, and large tables to spread out large or fragile folios. Map collections may be small enough to be attached to the reference area. Even so, they are space intensive, as the materials involved may require relatively large flat files, large tables as nearly as possible, and special equipment such as light tables.

Music and Audiovisual Resources
Assuming that a separate music or film library is not warranted, such program needs may be included in a main library. Music materials—sheet music, all types of recordings, and film and video collections—require custom treatment in terms of storage, management, access and use, and maintenance. Given the special equipment involved, these materials will almost certainly have their own discrete area and access control within the library. Some libraries may include recording facilities and presentation spaces.

Computer Work Areas
Virtual every contemporary library project involves the provision of space and infrastructure for its information technology (IT) system. Typical systems currently have a central facility, in a central, secure space, with expandable servers supporting a local area network connected to the campus’s overall computer network. Cable tray systems are not uncommon as part of a facility’s infrastructure, using a changing array of wiring, such as fiber-optic cable or whatever will be its eventual replacement.

In addition to accommodations for personal laptops, new libraries typically offer shared computer facilities for student use. In the typical computer commons, a number of desktop computers are available for individual use, along with a service desk and attending staff or student assistants. Individual workstations may be complemented by a suite of small meeting rooms, with one computer in each, for team projects. Programmers for large or central campus libraries should also consider providing classrooms for computer interaction.

Ancillary Programs and Services
The contemporary campus library can be seen as a network of interconnected resources and services. At its core is an ever-expanding collection of materials, including print and other media, and the library staff who provide essential services and maintenance. Integral to this core facility are catalog and reference systems and primary work areas for users who need to access library materials and services in place. The following may be linked physically or electronically to the library core:

- The evolving media center, or information agora—a high-traffic forum that provides one-stop shopping for computer-accessed materials, reference sources, current periodicals, and other resources. This space may be combined with a café, large-screen displays for group activities, and even for-sale materials in print or other media.
- Team project/group study rooms, seminar rooms, and larger computer classrooms or lecture halls. Such
spaces may be located at the library entrance, outside the control point, allowing students to use nearby library resources without compromising the core facility’s normal operation.
- A student or community center, which may absorb the library as part of a larger assemblage of social and academic services. The center can include dining, retail, student services or organizations, and even a small theater. Smaller campuses find this model attractive for increasing the urban quality of life. By providing a lively center, such hybrids augment one of the library’s more traditional uses as a campus destination, whether for study or simply for a respite or social interval between classes.
- Campus computer networks, which allow access to much of the library’s resources from virtually anywhere on campus. To varying degrees, campus libraries may offer internet or dial-up access to outside users as well. The ubiquitous campus information network greatly expands the ways in which the library can serve its academic community.

PROJECT PROCESS AND MANAGEMENT

The process of planning and building a library has much in common with other campus projects. In the design phases there is an intensive three-way collaboration involving campus administration, academic users—in this case, librarians and key staff—and the design team. Each of these groups has a critical role in the success of the project.
- Campus administration typically means planners, architects, and engineers from the planning and facilities departments, but may also include capital projects oversight from central administration. Key responsibilities are client-side management, contracting with the design team, and watching over the schedule and budget. If site funding is provided, submittals, project data, and other requirements of state agencies must be coordinated so that deadlines are met. The college or university’s project manager is the point person whose level of skill and dedication can impact the effectiveness of all the participants.
- Librarians and staff are the academic user-clients. They communicate their needs, goals, and vision to the administration and the design team. This input is concentrated in the library program as a document to guide design and establish an appropriate budget. The librarians’ involvement from beginning to end of the project is especially critical, given the extensive detail of functional and operational concerns.
- The design team, directed by the architect, includes technical and engineering consultants, as well as those involved with design specialties such as landscape, interiors, graphics, and lighting. Engaging a library planning consultant, who has a principal role during programming and some role during design phases, is highly recommended for all but the smallest remodels. Also critical are acoustical consultants, as well as specialists in information technology (IT), who can best interpret and optimize the goals of IT staff.

As the project enters the construction stage, the three-way collaboration becomes a revised process, with emphasis on the ability of the campus project manager and the architect to work effectively with the contractor or construction manager to deliver the project as designed.

Within the programming and design phases, several factors make an enormous difference in the quality of the project and the long-term satisfaction of the librarians and other users:
- Continuity: Keeping the project leadership both the campus administration and the design team intact through all phases has great value in maintaining goals, schedule, cost, and details. If a retiring head librarian views the project as his or her legacy, then the new librarian should be included in the process as early as possible.
- Listening: One of the most important qualifications for the architect is the ability to listen—and to communicate well. A commitment to a collaborative process will invariably enrich the design.
- Proposals planning: Coordinating the schedules of administrators, faculty, and design consultants requires a thoughtful work plan that sees forth as much of the design process as possible at the start of the project.

UNIQUE DESIGN CONCERNS

Campus libraries respond to a variety of pedagogical and research needs, ranging from general student use to highly specialized support for individual departments and professional schools. Consequently, most campuses do not have a single facility, but a constellation of institutions, each with its own urgent requirements and its own accommodations.

Although their content and services may differ, most campus libraries present a common set of issues for design and planning:
- Controlled access into, and seeing within, the facility must be supported by a clear and efficient layout of reading and reference areas, stacks, and staff work spaces.
- Collections of materials must be shelved in reasonably contiguous areas, while allowing for expansion and reorganization. Reading areas need access to natural light, whereas stacks and computer terminals must be protected from daylight.
- Reader spaces must be generous enough to accommodate research needs and should provide a refuge for quiet study.
- A wide variety of seating, carrels or workstations, and generous table/areas must be well distributed throughout the library, close to research materials, as well as gathered in larger reading rooms.
- The circulation desk and reference area must be readily visible and designed to facilitate services provided by library staff.

Of all the pertinent issues, circulation and functional organization are of foremost importance in successful library design. Placing library circulation and the sequence and adjacency of program components is driven by several key concerns:
Controlled access and security—
typically through a single point of entry
Overall orientation and ease of
wayfinding for users
Ready access by users to most-
frequented facilities, such as reference
areas, circulation desks, reading room,
and vertical circulation core
Efficient movement of staff to all
service areas

The library program must carefully set
the best organization of adjacencies.
Depending on the particular nature of
the library, special functional areas may
take prominence, such as licensing rooms
in a music library, or periodicals in a sci-
ence library. Spaces for some auxiliary
functions may best be located outside the
main entry/security checkpoint, such as
classrooms, lecture rooms, group study
rooms, 24-hour reading rooms, and exhi-
bition or multimedia spaces.

Clarity of circulation greatly enhances
library use and reduces the dependence
on signs for wayfinding. A variety of
strategies may apply:

- Shape, scale, and three-dimensional
  form of aisles, corridors, and other
  movement spaces
- Visual continuity, visual axes, and
  open vistas from room to room
- Open stairs and visual continuity
- Memorable spaces for important
  functions, which help the user form a
  quick and lasting mental map of the
  library
- Exterior views and natural light, to
  reinforce important sequences of
  movement
- An overall building order using clear
  geometry and spatial hierarchy

The last point is illustrated by some of
the most celebrated library archiectures:

- In Sir Christopher Wren's Trinity College
  Library at Cambridge, as well as in Louis
  Kahn's Phillips Exeter Academy Library.

The spatial order of the library has not
only enhanced its use, but has represent-
ed the ordering of human knowledge that
is at the heart of the library's meaning.

Although these are the historic concerns
of library design, they lose none of their
importance under the influence of more
contemporary developments in media
and technology. As new activities and
systems are added to the contemporary
library, it is important to think of them
as integrated with, rather than substitut-
ing for, the basics of library function.

The use of campus library facilities
vary considerably according to discipline.

Although a general, central library can
still serve most of the campus, some spe-
cialized collections, such as law resources,
are so integral to the academic program
that they are best located at the particular
departments. English majors and doctoral
candidates in history may make extensive
use of print materials in the stacks and
may be frequent users of nearby carrels.

Students and faculty in bioengineering
need ready access to research reports that
are not yet in monographs or periodicals.

Serving their needs means providing con-
nnectivity between libraries and researchers around the globe. However, as more and more material is digitized, the patterns of use adapt accordingly.

Current Trends Reconsidered
The campus library of the future may be less the subject of debate now than it was a few years ago, at least in terms of the impact of new technology. Academic librarians interviewed in a variety of disciplines agreed that it is no longer realistic to say that the computer will reduce the space requirements of libraries, let alone replace the facility altogether. Books will continue to be produced and collected. Banks of computer workstations require more, not less, space than the old card catalog. And all of the new systems and media point to a dramatic increase in power supplied to the building, as well as the expanding IT infrastructure to use it.

With the increasing array of materials, media, and systems, the expertise of the librarian becomes equally broadened. Campus librarians have expanded their role as instructor, leading classes on the use of both computer and traditional research methods. Information technologists and Web masters may now be added to the core library staff, providing new kinds of services. Some speculate that libraries may become small-scale publishers by selectively transferring the flow of electronic information into print.

In general, the new systems and patterns of use are now seen to be additive, rather than reductive of the core library operations. This is of real significance for operating budgets, as the anticipated replacement of electronics for print cannot be counted on. Many institutions will find that the operating cost of the old library must now be expanded by the operating cost of the new library. The implications for design are analogous: however up-to-date the systems are, good library planning must begin with the basics.

SITE PLANNING
Libraries are among the most public and widely used buildings on any campus, and consequently their site planning deserves very careful consideration. Main libraries in particular, because they are a destination for so many students at all hours, should be carefully located and may benefit from proximity to other
centers of after-hours campus life, such as food service. Professional school or departmental libraries have a more local set of relationships, and additions to existing facilities present even more localized challenges.

Libraries are also cultural institutions, representing the past, present, and future of human knowledge. The symbolic value of libraries has been an important consideration in their location on most campuses.

For all kinds of library projects, the issues of arrival and access, service and loading, and future expansion and change, present significant challenges. A good list of planning principles addresses both general facets and aspects particular to individual libraries:

- The unique spatial hierarchy of the campus, its major open spaces, significant buildings, and the character of the campus as a place
- Campus circulation, pedestrian and vehicular, including main points of entry, related parking, and service driveways, as well as public or local campus transit stops
- Social and functional relationships to other libraries in the campus system
- The scale of the facility, which may be intimate or one of the largest buildings on campus
- Orientation to daylight, microclimate, and views
- Opportunities to use entrances or views into the library to enliven important outdoor places of movement or gathering

- Requirements of the Americans with Disabilities Act (ADA), accessibility, and accessible parking provisions
- Proximity of service parking and off-campus visitor parking

For the classic problem of the library addition, considerations for site relationships will be very much a matter of context. Tight site constraints mean that preschematic planning should involve a study of alternatives, testing the ideal library program relationships against the reality of available land, light, access, and services. In designing additions, functional relationships of old and new space, floor levels, egress, and structural interventions all become aspects of site planning.

**CODE REQUIREMENTS**

Most libraries combine Uniform Building Code A and B occupancies, and given any program area over a few thousand square feet, must meet the requirements of fire resistant construction. In addition, new buildings most likely require a quick-response sprinkler system and both automatic and manual fire alarm systems. Emergency egress involves a classic conundrum with security, and all exit doors must have alarms.

- Particular features of design, such as mezzanines or other multi-level interior spaces, require specific solutions based on floor area, how many floors are open, mechanical systems features such as smoke flection with security, and all exit doors must have alarms.

- **ENERGY USE AND SUSTAINABILITY**

Libraries have the preservation of collections of print materials as a first priority, which normally requires careful temperature and humidity control, via mechanical air-conditioning. In addition, large floor areas of open stacks require artificial light, with limited or carefully controlled use of daylight. Within these given, there are a variety of opportunities for achieving the contemporary goals of energy efficiency and sustainability. Some of these measures have direct cost implications, but they are quite compatible with library functions:

- Building envelope designed for climate, well insulated, with a relatively low surface-to-volume ratio
- Use of efficient mechanical system components and lighting sources
- Sun shading and/or careful orientation of windows
- Occupancy sensors and other controls for task and general lighting, especially in infrequently used stacks or archives
- Reduced foot-candle levels for general illumination
- Building materials and construction systems using sustainable or “green building” practices, such as carpeting, other flooring, recycled steel, etc.
- Sustainable site planning with respect to existing infrastructure, adaptive reuse, proximity to public transit, etc.

Successful planning for sustainability often benefits from an opportunistic approach; finding the inherently sustainable aspects of the building type and maximizing their advantages. For example, libraries may offer limited opportunities for natural ventilation or night-purge cycles (which may bring in excessive levels of pollution) because of strict air quality requirements for maintenance of print collections. But other library requirements tend toward an energy-efficient volume or envelope. Goals for a sustainable building should be established early in programming, and new opportunities sought as the design proceeds (see also Chapter 2).

**STRUCTURAL SYSTEMS**

The structural framing for a library is closely related to the modular dimensions.
for book stacks and other areas that may become stacks in the future. Common considerations include the following:

- Typical live loads are 150 lb/ft² for normal stacks and up to 300 lb/ft² for compact shelving.
- Floors may be carried by either steel or concrete systems, with bay spacing in the range of 20–30 ft on center.
- Actual column size and layout are highly dependent on the planning of the stacks.
- Large open spaces, such as reading rooms, allow a variety of structural solutions, as long as they are open to the roof framing.
- Seismic bracing more often conflicts with floor plan flexibility, the alternatives being moment frames in steel and perimeter shear walls in concrete. In areas with significant seismic requirements, stack shelving is most often structurally cantilevered from the floor slab with engineered connections.

MECHANICAL SYSTEMS

The temperature and humidity control needed for proper maintenance of a library's collection calls for carefully zoned mechanical heating and cooling. At present this can be interpreted to mean some kind of forced-air system, with either a constant-volume or variable-air-volume arrangement.

Humidity is especially critical, and although most air standards typically call for 50–55 percent relative humidity, some sources suggest the need for relative humidity as low as 30–50 percent, with not more than 3 percent fluctuation. With proper humidity control, lower temperatures (e.g., 68°F) are favored.

Good distribution of the air supply can be an important challenge, as a library may have a wide variety of room sizes, ranging from low, broad areas of stacks, to tall reading rooms with mezzanines, to small offices and group study rooms. Clear ceiling heights above stacks, for example, determine how frequently supply registers must be located to provide proper distribution. Reading rooms need an air supply without drafts. Rare-book rooms and other special archives need a separate air handler and control. All heating, ventilating, and air-conditioning (HVAC) systems must be reviewed by an acoustics consultant; however, some background noise from the air supply system can be a positive feature, as discussed later, under "Acoustic Control."

ELECTRICAL AND COMMUNICATIONS SYSTEMS

Libraries, like most academic facilities, have a greatly increased need for power and data distribution because of the desire for a computer hookup at every table, chair, and workstation. Most library floor plans have electrical rooms on major floors and data closets on every level. Cable trays, either exposed or concealed in ceilings, are now standard. As new facilities increasingly move to wireless networks, data port wiring may become obsolete, but current facility designers see little choice but to include it currently.

Campus libraries are usually tied in to a campuswide computing network. A library may have its own local-area network, with a small space devoted to servers and other equipment, but those facilities can also be located elsewhere. Again, the key issue is an infrastructure that allows for adaptation to changes over the life of the building.

SPECIAL EQUIPMENT

In addition to stack shelving and computing facilities, as discussed earlier, most libraries use a variety of systems for stacking and reading materials in microform, microfiche, microfilm, and similar systems have evolved and are now ubiquitous. They each require special equipment and storage, and a convenient means of oversight by staff.

A microform reading room may include a dedicated service desk, storage on shelving or in cabinets, and reader stations of some 50 sq ft, each including the reading device and desk space. Because the equipment can be bulky and hard to relocate, and the collections have great potential to grow, it may be prudent to provide at least double the space need of the initial collection.

MATERIALS

Building and finish materials for academic libraries are subject to criteria similar to those for other academic buildings: initial cost, long-term use, and durability, without extensive maintenance, are important factors. Acoustical properties, discussed in the following section, are a special concern, and sustainability may become an increasingly high priority as well.

The combined issues of acoustics, light, and concentrated foot traffic make floor finishes a particular interest. Glass from shiny floors near a window may reduce otherwise careful lighting scheme or render computer screens unreadable. Window glazing must be selected with ultraviolet (UV) protection in mind, as well as heat gain. The relatively large areas of glass for daylighting may be mitigated by using Low-E, high-performance glazings. The additional cost may be readily offset by lower expenses for both artificial lighting and cooling. But most library design issues can be addressed with a wide range of commonly available materials.

ACOUSTIC CONTROL

Libraries and librarians are famously intolerant of noise, yet a library space can also be unusable if it is so quiet that the slightest sound is a distraction. Ambient sound, the white noise that comes from mechanical ventilation, from buffered outdoor noise, and sometimes from white sound-generating systems, is an important ally in acoustic design. A variety of planning and detailing strategies must be balanced to achieve a successful space:

- Careful organization of foot traffic and through reading rooms and work areas.
- Location and possible segregation of noise-generating activities, such as those associated with copy rooms, reference desks, staff work spaces, and group study, seminar rooms, and classrooms.
- Selection of floor, wall, and ceiling materials. Resilient flooring, such as cork and linoleum, has a long record of success in libraries.
- Adequate screening of exterior noise, especially at adjacent hallways, driveways, and other places where traffic is concentrated.

Ambient noise in the range of 40–45 decibels provides a good background for many open work areas. Larger spaces may allow slightly higher levels, as they are more public.

LIGHTING AND LIGHT

The desirability of natural light in a library is a persistent and powerful ques-
tion, in part because libraries have large areas of stacks where daylight is unwanted. Architect Louis Kahn spoke poetically of the moment of "bringing a book to the light." Others have explored the range of light sources from deep inside, where light enters from a roof or courtyard, to the outer edges, which offer abundant light that must be tempered. And although library activities are focused inward, a view to the outside can also be welcome.

Because library floor plates can be large — even sprawling — it is important to consider paneling and paneling, the deep interiors with light wells or courts. The multiple benefits include visual relief, a reminder of the time of day, and physical orientation. A skylit court can be combined with a stairway to enhance efficient circulation and wayfinding.

Kutner and Kim's Firestone Library Addition at Princeton adds two levels of dense stacks underground, using a skylit gallery as a zipper to attach the expansion to the existing Gothic building. The stacks are interspersed with wider aisles linking a variety of top-lit, double-height reading spaces.

As wonderful as natural light is, UV control is a serious problem. Even the blue end of the fluorescent daylight spectrum is unhealthy for books. Window-
LEARNING CENTERS

glass and lighting lenses that filter out UV—which the quartz lenses on halogen lamps do not—are essential.
The lighting design challenges for a library are similar to those in any workplace, with perhaps greater urgency, as reading is the predominant activity:

• Ambivalent lighting should be complemented by task or tablelamp lighting in most reading areas.

• Glare on computer screens must be minimized, helped by softening ambient light levels and by looking carefully at the ergonomics of workstations near windows.

• Stack lighting is a special problem, in which ceiling height, aisle width, and the lighting system must be adjusted so that adequate light reaches the bottom row of books. The more common stack lighting is a simple fluorescent tube parallel to the aisle, but if ceiling height is great, the lighting grid may be at angles to the bookshelves. Up-lighting the ceiling from the top of the shelving is also an option, but requires higher levels of output from the source.

• Ambient lighting in microform reading areas should be subdued.

INTERIOR DESIGN

In addition to the critical concerns of lighting and acoustics, the interior design of a library tends to be a matter of functionality and ergonomics at every level. Many items of furniture address special needs and activities: there are often custom-designed carrels, reference catalog tables, computer workstations, and many other specific solutions call for care in the dimensions, details, and choice of materials. For larger projects it is possible to have the makers of off-the-shelf furnishings produce custom items for a more consistent character and finish.

The choice of materials and colors generally has a strong effect on the atmosphere of a space. Strong colors in large amounts can be visually fatiguing in a reading room, but may be a positive relief in a stairway or other transitional space.

Seating—with the opportunity for natural wood and softer, upholstered surfaces—can relieve the prevailing feeling of "industrial strength" while still being durable. A variety of types and forms of seating, as well as length and smaller tables, is best, so as to offer choices to users.

In terms of character, it is good to remember that books themselves bring wonderful qualities of scale and pattern to a room. Great libraries are created simply with a large, geometrically formed space and a thoughtful pattern of bookshelves arranged within or around it. The sense of being surrounded by books, and the wealth of human imagination they contain, is the unique experience of a library.

WAYFINDING

Libraries are complex environments, with multiple centers of activity and highly specialized services. Good design of a library in terms of wayfinding is more than a matter of signage. It begins with the hierarchy and order of circulation into and through the library and is supported by many aspects of the design, such as the following:

• Inspirational shaping and sequence of movement spaces
• Use of natural light and views to provide orientation

• Open stairways that offer visual connection between floors
• Focal walls, featuring art or simply color, to establish destination or to end a vista.

With spatial choreography as a foundation, the library is also an intensive environment of signage and graphic information of several types:

• Code-required signage for existing, accessible routes, lavatories, etc.

• Building signage for room numbers, names, building and floor directories, etc. Room number and name plaques should also include a means of affixing daily or seasonal notes on paper to announce functions or events.

• Book stack identification with content-related numbering according to the library's catalog system. These should be simple, easy to change, and legible at 10-20 ft.

It is surprising how often new libraries, with otherwise very refined graphics, have hand-lettered range labels, usually installed after the designers have departured. This type can be improved by establishing a graphic template for staff to use to produce labels on desktop computers.

ADDITIONS, MODERNIZATION, AND ADAPTIVE REUSE

Most library projects are new phases of growth for existing facilities, and the problem of adding to a functioning library can be especially challenging. Expansions may serve a variety of purposes—increasing storage space, introducing new functions, or, in some cases, creating a whole new facility in which the existing building has a supporting role. Additions must resolve a complex of functional, structural, and code problems, such as the following:

• Maintaining access control or reorganizing the entrance and loading dock
• Ensuring continuity of the collection across new and existing stack areas
• Establishing new patterns of circulation and exiting
• Upgrading existing structures to meet current code requirements
Interfacing new and existing floor levels
• Temporarily relocating services and the library’s collections
• Maintaining temperature/humidity control during remodeling
• Meeting historic preservation standards

UCLA’s historic Powell Library was restored, retrofied for seismic and other requirements, partly demolished, reprogrammed, and remodeled. Temporary facilities were designed and built specially for this major overhaul and later purchased and reused by another institution.

The Hugh and Hazel Darling Law Library at UCLA is a major addition in which existing stacks were integrated with new stacks and the main reading room was remodeled to become the central feature of the new plan. The new steel frame was also used to seismically brace the existing structure.

INTERNATIONAL CHALLENGES
The conceptual challenges and detailed requirements of academic libraries in the United States have their equivalents in other countries, and although the particular standards vary, the criteria for good library design are much the same. Most European countries have readily available sources for standards, such as Germany’s DIN-Normen. Because library design involves great attention to modular dimensions, down to the half inch or centimeter, designers involved in foreign projects should carefully research code, building, and furnishing standards.
Most opportunities for American architects seeking such work in other parts of the world arise from international design competitions, which are far more common in other countries than they are in the United States. The most practical working arrangements for American architects is an association with a host country firm and local consultants. Well-funded, prestigious projects allow the option of international consulting for technical support, and many larger engineering firms have international practices. The latter are also an excellent resource for finding out about work opportunities overseas and the particular issues of practice in each country, which vary greatly.

In many developing countries, such as China, institutional projects may be available to American firms that take the trouble to form an association with local architects and engineers. Fees are usually a serious problem, as local fee levels rarely pay for international consulting. National or otherwise significant projects may allow for exceptions, particularly if an international design competition is involved.

**OPERATION AND MAINTENANCE**

Libraries are among the most intensively used of all campus facilities. For long-term success, the considerations of durability and adaptability are critical. To ensure ease of operation and maintenance, attention must be given to the following:

- Life-cycle cost analysis of mechanical systems, favoring more efficient and long-lasting equipment
- A thorough process of building commissioning and training for staff operation of systems, especially when they involve alternative practices to meet sustainability goals
- Efficiency and longevity of lighting sources, as well as ease of replacement; attention to special lighting elements such as UV filters, etc.
- Well-designed and detailed building envelope; careful treatment of building moisture protection, to assist humidity control over the life of the building
- Designing for staff efficiency and the minimum number required to run the facility
- Careful detailing of high-traffic areas, protection from book trucks, etc.
- Book stack layouts, and structural accommodation for them, allowing flexible rearrangement of the collection

Above all, the basic building fabric should incorporate simple, flexible planning, modular design, and workable building engineering systems such as cable trays, to mitigate the cost of change.

**KEY COST FACTORS**

Libraries as a building type present a variety of program and design features that have cost implications beyond those of other types of campus buildings. Some of these are more, and others less, affected by particular design solutions:

- Structural live loads for book stacks, which for greater flexibility should be applied to as much of the building area as practical. The live loads of compact shelving are much greater.
- The sheer volume of book shelving and other storage systems, as well as...
CHAPTER 4

ACADEMIC BUILDINGS AND PROFESSIONAL SCHOOLS

GRAHAM S. WYATT Robert M. Stern Architects

When Charles Klauder and Herbert Wise wrote College Architecture in America in 1929, four pages of text within the three-thousand-page volume were dedicated to the design of classroom buildings and only two types of rooms were discussed: a classroom (generally with 20 seats or fewer and a flat floor) and a lecture hall (with more seats and a sloped floor). The intervening decades have seen a revolution in educational theory and practice and an accompanying explosion in the variety and complexity of classroom types. Some recent critical discourse even proclaims that the term classroom unnecessarily narrows discussion and that the linguistically challenging phrase of learning more accurately reflects the fact that much learning can and should take place outside the traditional classroom environment. But although technology and changes in educational practice have broadened the educational playing field, classrooms (in a multitude of forms) are still at the core of the university teaching and learning experience and promise to remain there for the foreseeable future.

TRENDS

Although certain principles related to the design of classroom buildings have remained largely unchanged over the decades, a variety of trends are at work today, driving the ongoing evolution of classrooms and the buildings that house them. More than 90 percent of high


FINANCES, FEES, AND FEASIBILITY

Libraries tend themselves to funding through private gifts, given that a library may be large, specialized, and of highly respected and essential part of any campus. Unlike dormitories and student centers, they are not supported by student fees, but may also benefit from state or national programs.

The affiliation of the library, especially if it is a science or engineering library, may be of interest to foundations that support its particular discipline. The Fairchild Engineering Library of the California Institute of Technology was just such a case, which also received other grants for the use of cutting-edge information technology.

For new campusites with state funding, money is often tied to increases in student enrollment, and some ingenuity may be needed in applying funds to non-office or classroom buildings. Libraries can, of course, also include offices and classrooms. Architectural and engineering fees on library projects are similar to those for classroom and/or departmental and professional school buildings, but may be somewhat higher because of a variety of design demands:

- Intensive involvement with clients to properly interpret program components and goals throughout the design and construction process.
- Demanding structural design, especially for seismic zones and additions or remodeling.
- Excessive design of furnishings, custom fixtures such as a circulation desk, and the integration of general and task lighting for a variety of workplace settings.
- Special consultants for library programming, feasibility studies of alternatives such as compact shelving, off-site book storage, etc., acoustics, lighting, and codes.

Although many excellent libraries have been designed by architects doing their first such project, prior experience with library issues, combined with attentive licensing, can be of great benefit in developing this detail- and functionality-driven building type.