

## The Library Environment and the Preservation of Library Materials

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**I**t's too hot! It's too cold! There's no air in here!" Familiar complaints? Yes, you hear them often from people, or maybe even from a computer that won't work if it's too hot or humid. Books, too, complain about the environment, but they do so quietly and over a long period of time.

### The Library Environment

Library buildings are a rare blend of environments: storage space much like museum storage, and staff and user space that must provide people with a comfortable environment. In most libraries these two environments are meshed into one; books and users intermingle. Ideally they would not, allowing facilities managers to concentrate on the ideal environment for books in one zone, and for people in another. As this usually is not possible, the facilities manager ends up making a compromise between the two.

The vast majority of HVAC systems are designed and operated primarily or exclusively for human comfort, but the environmental requirements for the preservation of library collections are somewhat different than those for human comfort. Because people are more vocal and less sensitive than the materials, the environments tend to be designed to meet more minimal human standards. But library collections are being subjected to whatever conditions are maintained in the building twenty-four hours a day, 365 days a year, whether people are present or not. In fact, the environmental condi-



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tions suitable for research libraries are closer to those of museums, laboratories, or medical facilities. It is crucial to the long-term preservation of library materials to provide them with the maximum standard environment possible.

### The Library Collection

Even a small library usually holds hundreds of thousands of books, manuscripts, sound recordings, videotapes, compact discs, records, audio-

tapes, photographs, and works of art. Each item was chosen with deliberation to meet a specific need of the institution's curriculum or research. Most cannot be easily replaced, and even if replacement is possible, the cost of adding each item to the collection again is prohibitive. Therefore, it is necessary to preserve this major capital asset of the college or university. To replace an average small collection of 100,000 volumes, if it were possible, would cost close to \$7 million. A new book averages \$35 these days, and it costs about as much to accession and catalog each title for use. Most titles are no longer available because the publishers cannot keep them in print indefinitely; they would have to be replaced through photocopy or microfilm, a costly prospect.

The larger, more complex research libraries have an even more severe problem in that very little of the materials they hold are replaceable. Rare book and manuscript collections that hold unique and valuable materials are by definition irreplaceable except at great cost.

There are libraries that hold materials for only a short time, such as a reserve collection, where the needs of people take precedence over those of the materials. Discussion with librarians should make it clear which library environments do not need consideration.

### The Problems of Deterioration

Preservation librarians think in terms of two forms of damage to library materials: chemical and physical. The chemical damage is a result of "inherent vice," the agents within the materials themselves that cause deterioration, and the environment that reacts with these agents. Chemical damage is impossible to reverse.

Physical damage is caused by use—

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the torn pages, the binding breaking away from the text, the spine detaching from the covers. This type of damage can most often be repaired for a reasonable cost.

Bad paper is the worst single preservation problem in larger and older research libraries. Surveys have shown that between 25 and 40 percent of the oldest, richest collections in the United States are embrittled.

A number of changes in papermaking technology came together about the middle of the nineteenth century, resulting in books that have become so brittle that they often cannot be used without pieces of pages breaking off in the hand of the reader. While good storage environment will not make a brittle book usable again, it will slow down the rate at which books move over the line from usable to unusable.

A dramatic example of the effects of environment on deterioration of books is two groups of identical nineteenth century Dutch pamphlets. One set is kept in the national library of the Netherlands, which has good environmental conditions (low pollution, lower temperatures, more constant relative humidity), and the other is in the New York Public Library. NYPL, located in the middle of New York City, did not have air conditioning until a few years ago. The Holland publications are in pristine condition, while the NYPL's had to be replaced with microfilm since they could not be handled.

A number of generalities can be made about environmental conditions for conservation of research library collections. The lower the temperature, the more constant the relative humidity within limits of 30 to 50 percent; the less light they are exposed to, and the cleaner the air, the longer the books will last.

### Environmental Agents in Destruction of Library Materials

**Temperature.** The speed of chemical reactions is directly related to the temperature; therefore, the rate of the deterioration of materials is accelerated in a higher temperature. In fact, the Arrhenius equation shows that a ten degree Centigrade rise in temperature doubles the rate of deterioration.

**Humidity.** Paper and other book materials are hygroscopic and absorb or lose water from their surroundings. High humidity causes loss of strength and increased incidence of mold dam-

age; low humidity causes loss of strength due to embrittlement. Quick changes in humidity hasten the movement of deteriorative materials within the paper from sheet to sheet, and cause book structures that absorb humidity at different rates to break down.

**Pollution.** Chemical pollutants such as ozone, sulfur dioxide, and nitrogen oxides accelerate the degradation of the paper. Particulate pollutants, dust, and soot also bring acid into the books, but also act as abrasives, to cause physical damage. Conventional filtration only removes particulate pollutants.

**Light.** All light is damaging to library materials. Ultraviolet light, the highest energy wavelength, is most damaging, but the damage is due to both length of exposure and amount of light. Materials in direct sunlight from unshaded windows show fading quickly. Materials under ultraviolet light for only a small part of the time show damage only over a long period.

Research has demonstrated that a stable environment that maintains the temperature at approximately 65°F and the relative humidity approaching 40 percent will significantly extend paper's longevity. To preserve library collections, the HVAC system should maintain these standards, and also filter particulates and gaseous pollutants from the outside air. Research is under way currently to determine the exact temperature and relative humidity requirements for different types of materials. For a mixed collection these settings are considered ideal at this time.

In addition, libraries have attempted to cut down light through putting lights on timers where possible, adding shades or ultraviolet-filtering film to windows, and installing ultraviolet shields on fluorescent lightbulbs. Reducing light also provides for energy saving, and therefore lowered costs.

There is a committee working on formal environmental standards for the storage of books and manuscripts that will be issued by the American National Standards Institute. Such standards already exist for the storage of photographic materials.

### Planning New and Renovated Buildings

Librarians and preservation administrators, library and museum environmental control experts, and consultants should be brought into the

planning process for new or renovated buildings. They can help determine major concerns, special problems (e.g., specific types of systems, filters), needs of the materials to be housed in the building, and compromises that may be made. Understanding the facilities requirements can lead to changes in planning, e.g., zones for book storage or locations of book stacks by librarians. In addition, libraries may have special requirements during construction projects in order to prevent damage from dust and dirt to the materials.

To complicate matters even further, many library collections, especially rare book collections, are housed in historic buildings. The collections need to be preserved, staff and researchers using the collections need to be comfortable, and the building needs to be preserved. In some cases this will mean creating an interior shell for the collections to keep from damaging the building itself.

There are also specific considerations in design of new buildings and HVAC systems that have a direct influence on the ability of librarians to preserve their collections. The following are a few points that may not be immediately obvious:

- The basic idea of preserving collections is to put as good a barrier as possible between the collections and the hostile environment. This implies that the ideal preservation building consists of a double shell between the collections and outdoors. Therefore, a building such as Columbia University's Butler Library, with air-conditioned windowless stacks in a central core with offices and reading rooms on the outside perimeter, even though built in 1934, is exactly right for the preservation of the collections.

- Removing gaseous pollutants requires expensive, special dry-bed adsorbers that are also expensive to maintain. The rate of loading of these adsorber beds, as well as particulate filters, can be reduced by careful location of fresh air intakes. One of the Columbia libraries has the intake directly over a busy bus stop, an obvious example of poor placement.

- Humidity control is one of the biggest problems in design. In cold climates, clean steam humidification is required in winter, and both chilling and reheat are required to dehumidify, especially in cool, damp weather. Often the control cycles and systems are compromised because energy con-



servation is the prime objective in the design, seriously limiting the preservation of the collections.

### Maintenance of Environmental Systems

Obviously, good maintenance procedures benefit everyone. Even where systems were designed with conservation of collections in mind, one quite often finds that they are not being operated that way. They may be turned off at night, humidifiers may have long been disconnected, or lower-rated filters are being used.

The following are maintenance procedures that particularly impinge on the preservation of the collections.

- *Relamping.* Low-UV fluorescent tubes or plastic UV-absorbing sleeves are installed in rare book and exhibition areas to reduce damage from UV radiation. Workers doing relamping, especially contractors, seldom know the purpose of these precautions and relamp with regular tubes and discard the sleeves.

- *Air filter maintenance.* Because of the damaging effect of dust on library collections, air filters should be replaced with ones as efficient as the filters they are replacing. In fact, replacing them with higher efficiency filters will benefit collections if the air-handling system can accommodate them.

- *Calibration of sensors.* No system can maintain closer control than the accuracy of its sensors, and humidity sensors are notoriously unreliable. Frequent recalibration is essential.

- *Humidification equipment.* This equipment requires high maintenance, and about half the time it is found to have been disconnected at some point. Recent research has shown that cycling RH between 40 and 60 percent significantly accelerates the aging of paper. Effective maintenance of the humidification system is a high priority for preservation.

Another issue, inevitably, is cost. Some features further both collections conservation and energy conservation; for example, fine control to reduce energy waste, maximum thermal barriers, and reduced lighting. But others, especially twenty-four-hour operations, are energy- and fund-burners. Air-side economizer cycles, which are sometimes found in HVAC systems built since the 1970s, do exactly what is counter to preservation: they bring in unconditioned outside air. In addition, energy-saving measures such as raising the chilled water temperature

reduces dehumidification, which leads to accelerated chemical deterioration of paper, wider seasonal extremes, and increased possibility of potentially devastating insect infestations.

### Housekeeping and Control of Biological Agents

Cleaning of general library stacks is usually done when the library is closed, and increasingly by outside contractors. Inadequate cleaning of floors can encourage insects. Careless mopping, stripping, and waxing with consequent splashing onto books, as well as smoking or eating in the book stacks, present real hazards to the collections. At some libraries it seems that whenever the cleaning staff waxes the floors in stack areas, the bottom two shelves of books get waxed as well. This is disfiguring—in some cases obscuring information—and difficult, expensive, and time-consuming to remove.

The materials used to clean the buildings and books are important. Cleaning cloths impregnated with mineral oil are often used; mineral oil is not toxic to books, but it leaves a residue that will attract more dust. Therefore, the use of cloths that attract dust through static electricity is recommended. Also, vacuuming, while useful, must be done carefully. A book is a delicate balance of physical forces, and any use can damage the binding or the paper. Vacuuming indiscriminately can lead to loss of information; the paper from brittle books is easily sucked up into the vacuum. Of course, this type of paper, often in cornflake form, requires the cleaning of floors on an intensive regular schedule.

### Insects

Facilities managers are the experts in dealing with silverfish and cockroaches, while librarians see the evidence of their damage. Silverfish and cockroaches love the glues and sizing in cloth bindings. Libraries have made many attempts to keep library users from having pizza delivered directly to the reading room and to see that the sodas, burgers, bagels, and coffee are consumed outside and away from the materials. However, we have been almost completely unsuccessful. So the answer becomes better prevention; for example: emptying the library trash cans continually and exterminating when necessary in an integrated pest control program.

### Mold

Mold and mildew is another problem for books and paper, as well as other media. If the humidity and the temperature are too high, the mold and mildew will attack and weaken the components of the materials. To clean mold and mildew requires a time-consuming, book-by-book wiping operation, along with a thorough disinfection of the entire area.

### Disaster Protection

A librarian's most stressful time is when the pipes are leaking, there is fire or smoke, or the roof leaks. In most library buildings, this seems to be a continuous problem. Wet paper is extremely fragile. If the paper is coated (like most art books, and medical and scientific journals), when it dries the book could be used as a building brick. Damp and wet paper can be air dried naturally or freeze dried, but it has to be done immediately. And although it may be dry, the paper is cockled; the books are never the same. Librarians depend upon the facilities people both to prevent this type of damage and to assist in the cleanup.

In a fire, the less water the better, but you can recover books from water; in fire, they're completely gone.

### Fire Suppression Systems

There is much controversy among library preservation professionals over which are the most effective fire suppression systems. No one wants to lose a collection to fire, but water damage is often the immediate cause of damage. Which is best: dry pipe sprinkler systems (which have a tendency to fail occasionally), a wet pipe system that results in water running over the books, Halon, or something quite different? Halon used to be the suppression of choice for special and rare materials, but the force in which it comes out and the residue left on the materials have posed problems. In any case, this method may shortly be banned because of CFCs.

### Disaster Planning

Disaster planning for a library is the library's responsibility, but it cannot be done in a vacuum. The facilities and security people should be involved, both to provide training, instructions on whom to call when and for what need, and for mutual understanding of needs and problems. It is entirely possible that librarians do not

realize that plans do exist. Facilities managers are in a position to remind librarians of the dangers and possible resulting damage of disasters and to be helpful in initiating this type of planning.

An open question: Why is it that the testing of the sprinklers often is done without warning, sometimes creating an unnecessary disaster? Librarians can understand that there is a need to test the sprinklers, or to blow soot out of the air conditioning ducts, or to leave the heat on after the weather has been warm outside, but some warning time would enable the books to be protected first.

### Library Preservation

Preservation includes more than improvement of the environment. The environment is the most important factor in the preservation of library materials, and seems always to be the most difficult because it is expensive and administratively complex. The field of library preservation is relatively new; only a few libraries have preservation professionals. Those that do, and many of those that do not, include these preservation activities among their continuing functions:

- Control of the environment to prevent deterioration.
- Physical treatment: repair and re-binding of library materials.
- Reformatting: replacing brittle materials by photocopying or micro-filming the original.
- Conserving materials with artifactual value in special collections.
- Writing policies and procedures that prevent damage.
- Training and educating staff and users to preservation and their role in protecting library materials.

In addition, through national cooperative efforts, an initiative to im-

prove the quality of paper through the use of alkaline paper-making processes has begun in Congress and with book publishers, agents, and authors. This should help to prevent the brittle book problems of the future.

Other preservation strategies currently under development include mass treatments to neutralize the acid in paper and to strengthen paper. New reformatting technologies, including machine-readable text files, are also on the horizon.

### Communication Between Facilities Managers and Librarians

Library preservation is a relatively new concern. It is important for the physical plant administrator to understand that most librarians are not yet involved in preservation and know little about how to accomplish the improvement of the environment. The facilities manager cannot take for granted that the librarian will understand the problems inherent in providing the ideal environment. We need to take the time to talk to each other—to plan and to learn step by step.

On the other hand, some librarians may feel more secure using a consultant with a track record in library buildings and renovations to foster the communication. This is even more true when outside contractors perform the actual work.

### Conclusion

Library materials are a product of an intellect putting ideas together for transmittal to others and a physical artifact produced from various organic materials that inevitably decay. It is the responsibility of academic institutions to ensure that these materials housed in libraries remain available to scholars and students. The most cru-

cial aspect of preserving these materials is the environment in which they are housed. To perform this function requires the cooperation of the physical plant managers and the librarians.

There are many types of buildings on a campus that require special environments—the library is just one. It has been suggested that we think of books as laboratory animals. They have their own needs and life cycle; but they do not bark or squeal. Yet books can continue to die horrible deaths from heat, high or low relative humidity, pollutants, poor or damaging housekeeping, insects, fire, and flood. It is our common goal to keep them alive for as long as possible.

For further information on the effect of the environment on library materials:

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### APPA Plans Seminar on Preservation of Library and Archival Materials

February 28 - March 1, 1991  
Washington, D.C.

This exciting new educational program will explore the specialized facilities needs of libraries and archival materials storage. This seminar seeks to improve communication and understanding between facility users and facility managers by increasing awareness of needs and priorities.

The program is organized in two parts: problem identification and evaluation, and maintaining the best environment. Faculty members will include higher education administrators, library directors, facilities managers, and other specialists. The cost is \$295 for individuals from APPA member institutions; \$345 for all others. To register or to receive additional information, contact the APPA office at 1446 Duke Street, Alexandria, VA 22314-3492; 703/684-1446.

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