Low Energy, Low Technology, Low Toxicity Approaches to Preservation

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> The following article is a slightly modified version of a paper presented at the ICA Preservation Committee Meeting in Oslo, Norway in May 1994. Some of the recommendations found here are made specifically for archives that lack adequate and affordable energy supplies and whose access to technology is severely limited. Other recommendations apply regardless of the availability of energy and technology.

Facilities Location and Construction.

Archives should be located in areas safe from flooding and, if possible, free from high heat and humidity, pollution, and particulate problems. If archives are constructed in earthquake zones they should incorporate special construction techniques to provide protection.

Archives buildings should to the extent possible incorporate construction techniques that minimize dependence on high-energy preservation measures. Every situation is different, but certain design features are often beneficial. Where energy costs or scarcity prohibit the consistent and uninterrupted use of air conditioning, construction features should minimize heat buildup and permit natural ventilation. Thick walls, for example, create heat. A light colored building exterior helps reflect heat. Shutters and roof overhangs provide protection from external light damage. If the archive is built in an area with high humidity and strong prevailing winds, it can be oriented so as to best catch the natural breezes. On the other hand, if the area is dry and has serious problems with dust and blowing sand, this may not be a good idea.

The air flow around and through an archives can be improved in tropical climates by constructing the facility around a courtyard. Hollow bricks (appropriately reinforced with steel in earthquake zones) made of local materials also provide an insulating effect. In Columbia, for example, an archival facility was built with exterior walls consisting of three layers of hollow brick with air spaces between, and with steel reinforcement. This example combines traditional construction methods with earthquake-resistance technology. Adobe can also serve as a heat and humidity buffer, but it should not be used for buildings of greater than one level in earthquake zones. Light colored stucco also helps moderate excessive heat, while protecting the building materials beneath from the weather.

In warm, moist climates the building should contain numerous windows, shutters, or panels, that can be opened to facilitate air flow. These should be

recessed and combined with overhanging roofs or awnings to lessen damage from direct light and rain. Of course, it is necessary to cover external openings with fine mesh screens to keep out insects and other pests. In colder climates thick masonry walls, like those in medieval European strong rooms, absorb and release humidity and heat gradually and thus moderate fluctuations inside the building. There should also be an insulating airspace between the thick walls and the external membrane of the building. In the winter the airspace also helps prevent water condensation on cold interior walls.

Underground construction is sometimes a suitable way to save energy in locations that are not subject to flooding. A subterranean location is a low energy solution for maintaining relatively constant temperatures. However, there is a corresponding dependence on electricity for all lighting and for humidity control.

Disaster Control.

Every archives must have a plan for disaster prevention, preparedness, and recovery. The precautionary measures, planning, and response techniques involved with disaster control do not necessarily require huge expenditures for energy consumption or technology; nor need they result in harm to the environment. Disaster control methodology focuses on risk assessment, measures to minimize the likelihood of disaster, the development of a disaster control plan, the creation of a disaster response team and a stock of disaster response supplies and equipment, and a series of carefully rehearsed rapid response techniques and long term recovery actions.

Security.

Good security, of course, is a basic and essential preservation technique. It can involve sophisticated and relatively expensive surveillance cameras and video recording devices, as well as electronic locks, gates, and electronically locking moveable shelving. On the other hand, such traditional methods as secure building construction, limited access to stack areas, bars on windows, traditional locks and gates, and human guards and staff surveillance are strong deterrents to would-be thieves and vandals. Search rooms designed so that staff routinely pass above and around the search area add to the deterrent effect. Such oversight areas exist at the State Archives in Raleigh, North Carolina and at the National Archives in Columbia. Secure masonry construction, battery backed-up security alarms, and human surveillance are not expensive, nor do they require the use of high-tech, high energy, or environmentally harmful methodologies.

Fire Detection/Control.

Fire detection and control systems can involve expensive electronic monitoring equipment and costly, environmentally damaging Halon fire

suppressant systems. However, low-tech, low energy, and environmentally safer methods are also available. Smoke and heat detectors, sprinklers, hoses, and misting devices require modest amounts of energy and pose no major threat to the environment. Most smoke detectors do contain a radioactive isotope that should be disposed of in conformance with relevant laws and regulations.

Misting-type sprinklers appear to offer an attractive, low energy, and environmentally safe way to suppress fires in film vaults where high-volume sprinklers pose a major threat to the holdings. The misting devices are currently being tested in the United States for their effectiveness in protecting paper-based as well as film-based materials. If they prove effective, they may greatly reduce the amount of water needed to suppress fire, and thus may result in less extensive water damage to holdings. They may also help conserve water, a consideration in areas where water is scarce or costly.

Temperature and Humidity Control.

Ideally, temperature and humidity conditions should be maintained at relatively constant levels specific to each material or medium type in the holdings. In climates prone to high temperature/high humidity conditions there is an ever-present threat of severe mold infestation. Very powerful, sensitive, and sophisticated climate control systems can maintain a wide range of set points. However, such systems consume great quantities of energy. One of the greatest dangers to records is a sealed building in an energy-starved location. A sealed building with high-tech air conditioning and dehumidification systems that must be turned off frequently to conserve energy is an invitation to a mold infestation disaster. The goal, then, should be to try to achieve acceptable temperature and humidity levels while consuming as little energy as possible and utilizing materials and methods that are as environmentally safe as possible.
Building systems and materials should mitigate fluctuations in temperature and humidity. Insulating materials and construction methods mentioned above (such as adobe, hollow brick, masonry, stucco, etc.) can help decrease and slow down fluctuations in heat and humidity.

Moving air can make the difference between healthy collections and a sick, mold-infested building. Locating the building on a site with fairly constant breezes can be beneficial. Courtyards, protected windows, and stack aisles that line up with natural and artificial airflow are important passive methods for diminishing the dangers associated with moist, dead airspace. Locate intake and exhaust fans along the axis of stack aisles with exhaust fans placed high in the walls. Air intakes should be positioned to pull air that is as pollution free as possible into the building. Intakes should not pull in vehicle exhaust, or smoke or exhaust from nearby structures or the archives building itself. The idea is to exhaust stale air, while pulling fresh air into and through

the stack areas of the building. Even when conditions outside become so bad as to preclude bringing large quantities of air inside, good air circulation (using fans as needed) within the building is important.

Humidity can also be mitigated during the worst season through the use of fans, dehumidifiers, and desiccants. The latter can be heated periodically and reused. Dehumidifiers use less energy than air conditioners, but do require daily maintenance checks.

Wind and solar energy systems are not low technology, nor are they inexpensive to implement. However, in the future they may provide renewable, environmentally safe, and inexpensive sources of electricity for lighting and temperature and humidity control.

Photographic film-based materials are at risk when stored in high temperature, high humidity environments. In such locations simple household refrigeration and freezer compartments may work for institutions with small holdings. For larger holdings, insulating panels, suck as Bally walls, can be used to create a room within a room. Such an insulated room, together with a desiccant-type air conditioning unit, can provide cool and very low humidity conditions above ground with a modest expenditure of energy.

The housing within which we store archives can be an extremely effective low-energy and low toxicity defense against temperature and humidity fluctuations. Paper or cloth wrappers and papers boxes that completely enclose the records serve as heat and humidity buffers that can moderate fluctuations and absorb moisture that would otherwise be absorbed directly by the holdings. When conditions moderate these protective materials shed their excess heat and moisture into the moving air around them. Archives boxes with pull cords are preferred over those with holes through the box wall, because they more fully protect the records. Multiple layers of paper separated by air pockets are especially helpful. For example, place records within a wrapper or folder that is placed within a closed box that can be placed within a larger closed box.

Particulate and Pollution Protection.

If the archives already has a central air handling system, particulate filters are available at little cost. Filters should be monitored and changed regularly. Activated carbon pollution filtration material is highly effective, but may be difficult to obtain and monitor in some areas.

Many repositories use external ventilation systems that carry dust and pollution inside. Ideally, the archives should be placed distant from pollution sources. If that is not possible, traditional techniques and materials can mitigate the problems of dust and pollution. In many countries a finely

woven cloth material is manufactured that can be fastened over windows (curtains, as it were, fastened on all four sides to the wall). These permit air to enter, but eliminate at least much of the dust. In a Costa Rican museum, a visitor noted, for example, that the interior side of such material appeared clean, while the exterior side was extremely dirty, indicating that the cloth was acting as a natural filter. Of course, such makeshift filters should be cleaned or replaced as needed.

Housings, especially paper housings, are the other major protection for the holdings in such circumstances. Wrappers used to protect bundles of records are often found covered with dust and even soot, while the records inside are clean. The worst thing to do in such situations is to remove the wrappers and leave the clean records exposed to dust and pollution. Multiple layers of paper are an excellent protection in situations where filtration systems are deficient. Good paper that meets ANSI or ISO standards for permanence may not be available locally or may not be affordable. If that is the case, custodians should first try to obtain alkaline paper with a calcium carbonate filler. Cigarette paper is available in many countries and generally is alkaline. If alkaline paper cannot be found, it may be necessary to use a low acid or nearly neutral paper (preferably after it has been deacidified in-house) to provide pollution and particulate protection.

Light.

Heavy use of artificial light consumes large amounts of energy and can also increase the heat inside the building. This is true even of relatively energy-efficient fluorescent lighting. Moreover, in some areas electricity is frequently rationed, and artificial lighting is at times a luxury. A recently constructed archives building in South America, for example, uses energy efficient underground records storage. However, electricity is rationed, and staff must at times carry their own light into the stack areas.

Sunlight can harm records through its brightness and its ultraviolet radiation. Yet if used with care, it can be used to provide indirect light even in stack areas. First, aisles should be oriented so that light passes through the aisles, and not directly onto records. Second, windows should be deeply recessed, and roofs built with a large overhang so as to require sunlight to enter indirectly. Louvered shutters or blinds can also be used to make the light indirect. Windows can also be covered with ultraviolet filtering material, if it is available. It is also possible to utilize skylights that reflect sunlight off walls covered with paint containing ultraviolet-absorbing pigments, such as white titanium dioxide.

Mold Control.

If despite our best efforts, a mold infestation breaks out, it is necessary to stabilize the conditions that produced the mold, segregate the infected materials from the remainder of the holdings, and deal with the mold

infested materials. Stabilizing temperature and humidity is dealt with above. If the shelving has become covered with mold, it should be cleaned. Formerly, it was customary to recommend cleaning with materials containing fungicides. Now, it is generally considered adequate to use the more traditional method of carefully washing the shelving with soap and water.

The infected materials should be removed from the stack areas, and infected housings discarded and replaced. If the records have visible mold on the surface, carefully cleaning them under a fume hood or in a secure area outdoors is now preferred to chemical treatment with thymol or other fumigation techniques. (Mold spores, after all, are everywhere. It is not possible to create a sterile work environment.) Reformatting may also be necessary in cases where the original records are seriously weakened. Staff handling moldy records should wear face masks and gloves and avoid inhaling mold, as it can cause serious health problems.

Insect Control.

Until recently, archival institutions have controlled insects by spraying insecticides regularly in stack areas as a preventive measure, by poisoning the surrounding and underlying soil to keep termites and other cellulose eating insects outside, and by fumigating infected holdings with hazardous chemicals.

More recently, as concerns about toxicity and the environment have grown, the heavy and routine use of broad spectrum insecticides for prevention has come to be seen as an unnecessary expense, and a needless health and environmental hazard. Instead, other more traditional and less hazardous methods have been employed to help prevent and deal with insect infestations. While such chemicals as sulfuryl fluoride (Vikane) may be necessary to deal with actual infestations, the tendency is to use insecticides as a last resort and to see them as a small part of pest control. When dangerous insecticides are used, they should be used with extreme care by personnel trained in their use.

Taken together the full array of pest control activities and practices have come to be called Integrated Pest Management. Good housekeeping, frequent inspection, and other preventive measures are key elements of IPM. Using metal shelving and keeping records off the floor and away from walls makes inspection easier and makes invasion by termites much more difficult. Metal shields can also be placed beneath and extending beyond any structural members that touch the ground or that touch other members that touch the ground. These prevent termites from building protective storage tunnels up into storage areas. Use insect traps to supplement stack inspections.

In India and China traditional herbs and plants have been used with success as insect repellents. Chinese and Indian conservators have reported at international conferences the use of herbs in small dishes kept on the shelf near stored materials. At worst the use of such herbs is a fairly innocuous measure that may discourage direct contact with the materials. At best, their use is a less toxic way than routine spraying to discourage potential pests. Another potentially useful measure is to plant insect repelling plants around the base of the facility in place of purely ornamental plantings.

In the event that insects are discovered, staff should consult an entomologist to identify the insects and select an insecticide that is specific to the particular pest, and ideally, one that is relatively safe to the larger environment. This approach is superior to exposing staff and the environment to a monthly deluge of broad band insecticides used as a preventive measure.

Until recently there have been no substitutes for using toxic and environmentally harmful chemicals to deal with actual infestations of records. However, freezing has now been found to be effective in destroying many species of insects. Rapid freezing or freeze-thaw cycling appear to get the best results.

Termites are another matter. In many areas there is no substitute to treating the soil with highly toxic chemicals. Recent research suggests other, less toxic approaches that interfere with the breeding and feeding cycles of termites may soon be available, but these methods are still experimental.

Handling.

Improper handling by staff and researchers poses a great danger to holdings. This problem can best be minimized by establishing policies on proper handling, by supplying devices and equipment for the safe transport and research room use of records, and by educating staff and researchers in proper handling techniques. There is nothing particularly high tech about these approaches, and certainly they pose no threat to people or to the environment. They do require discipline on a continuing basis.

Exhibition.

Exhibiting archival materials has become a popular part of most archival programs. There can be significant public benefits from an active exhibit program in the form of increased visibility and even increased resources for the archives. The exhibited items may even benefit, because in the course of being exhibited they may receive a condition review, rehousing, and conservation treatment. On the other hand, improper exhibition can result in immediate physical damage and longer term deterioration from exposure to light, pollution, and poor storage conditions. Reasonable care and precautionary measures that do not require massive commitments of energy

and technology, and which are not harmful to the environment, can make short-term exhibition relatively safe for many documents. Some original documents, however, are so vulnerable to damage from exhibition that they should not be exhibited for even brief periods. In such cases, facsimiles should be considered, together with captions that explain to the public the damage that would result from exhibiting the originals. These explanations can serve as a useful educational device.

Housings.

Housings protect our holdings from fluctuations in temperature and humidity, from dust and pollution, and from the hazards of normal handling. Proper housings are not harmful to the environment or to people, and do not require high-energy consumption in their manufacture. In fact, pre-modern papers used for binding board and wrapping paper, as well as for the records themselves, were of good quality and provided good protection to the recorded information they contained.

The problems posed by modern acidic papers are well-known. A few points should be made, however. First, newer alkaline papers are gradually being introduced in some developing countries. Alkaline processes have come into widespread use in developed countries because they can be less expensive than acidic processes, and because they are less harmful to the environment.

Second, in areas where alkaline paper is not available, an alkaline reserve can be added to regular paper, which can then be used to wrap archival holdings. This approach, which has been used in some countries, is labor-intensive, but the tradeoff between technology and labor may be acceptable in some areas.

Third, if neither of the above approaches is possible, paper and cloth produced using traditional techniques may be acceptable. For example, untreated, well washed, all-cotton muslin or broadcloth of near-neutral pH may be used to line cardboard boxes or to wrap records.

Treatment.

Polyester film, ultrasonic welders, and expensive analytic equipment are not widely available in many areas of the world. However, many valuable, nontoxic, and low energy methods and supplies are available. Aqueous deacidification can be performed anywhere in the world. So can surface cleaning and repair with traditional starch adhesives and traditional quality papers. Much can be accomplished with simple tools and supplies, including pH testing kits. In this, as in so much in preservation, the one essential ingredient is adequate training of staff.

Reformatting.

Electrostatic copying capabilities are now widely available to produce archival photocopies of originals created using unstable processes. Care must be taken that the paper used for copying is of good quality and that the toner is adequately fused. Photocopies may also be used in reference as surrogates for fragile originals. Microfilming, too, is widely available as a preservation technique. Silver released during processing can be hazardous to the environment. However, silver recycling is a well established, inexpensive technique that protects the environment and provides a modest return on the investment.

In summary, we can do much to preserve archival materials without consuming vast amounts of energy or exposing employees or the environment to highly toxic materials. In many cases, traditional methods are the best approach in traditional as well as in technologically developed societies.

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