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With Plenty of Elbow Room: Planning New and Upgraded Spaces for Library and Archives Conservation and Audiovisual Preservation

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Abstract

In 2018, the University of Kansas (KU) Libraries upgraded from a tired, twenty-year-old basement space to a new, purpose-built conservation lab for library and archives collections. The new conservation lab, which is housed in the special collections and archives library, quadrupled available lab space for its conservators and fleet of student employees. The move afforded Conservation space in the same library as the most vulnerable collection materials. In addition, rooms in the special collections and archives library were repurposed for audiovisual (AV) preservation, creating two new spaces for film and video workflows and upgrading an existing small audio room. This paper will discuss the conservation and preservation lab construction literature and will serve as a practical exemplar of the challenges and successes of the planning process, including lessons learned and unexpected benefits.

Keywords

conservation, preservation, laboratory design, renovation, library, archives, audiovisual, case study, university, special collections

Introduction: Departmental History

In the early 1990s, the dean of libraries, William Crowe, launched a preservation task force for the University of Kansas (KU) Libraries, whose main recommendations included the need for a preservation librarian and conservator. The first preservation

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librarian, Brian Baird, was hired in 1994, and Crowe and Baird identified unused space on the first floor of the main library that could be retrofitted for preservation activities. The space was not ideal in some ways: it was multi-level, with stair access between the staff offices and bindery preparation area on the lower level and the lab on the upper level. Although a small elevator lift was added for accessibility and book truck access, having stairs within a department where library collections were moved around created challenges. In addition, the deep basement space lent itself to pest and water intrusion. However, with significant donations the circa 1,500 square foot space was turned into a fully functional preservation department, which opened in 1998, with a book conservation lab, supply area, office for the preservation librarian, cubicle area for other staff, and space for the bindery preparation and brittle books operations. The square footage was not large to encompass all of those workflows, but it was a significant first step. The first conservator was hired in 1997 to manage general collections book repair as well as perform conservation treatments on special collections items. For twenty years the department functioned quite well in this cozy space, which was conveniently located in the building with the greatest percentage of circulating books in need of repair. As the only fully functional conservation laboratory in the state, it served as a training center for staff at other universities and state institutions and as a preservation resource for the public.

In 2005 the department expanded its reach to include audiovisual (AV) materials, although there was not a space designated for AV preservation until around 2009. One of the first projects staff undertook was to move into the Libraries' care a large, long-play (LP) record collection that had been stored inappropriately in a university department. Much of the early work to clean and rehouse LPs was performed on site in the collections spaces. Eventually, one small room in the basement of the special collections and archives library was identified and outfitted for audio preservation. Its location away from office spaces made it ideal for audio playback in real time, but the room had not been upgraded since the building opened in 1968 and was dismally outfitted. Still, it was the first attempt to professionalize audiovisual preservation efforts at KU Libraries.

By around the year 2010, it was clear that the department had outgrown its spaces. The University of Kansas Libraries followed national trends in library preservation and conservation, with general collections workflows declining in focus while special collections conservation streams increased. This shift is the result of a few factors, including: a decline in physical books being checked out, with subsequent lower amounts of damage in general collections; the movement to "expose hidden collections," often special collections and archives, including through digitization workflows that affect conservation treatment practices; the purchase of large digital packages that make libraries more similar in many general offerings, leading in turn to special or "distinctive" collections becoming more valued; and changes in the formal

education of library and archives conservators (Baker 2019: 83). In KU Libraries, as more of conservation's work required visits to Spencer Research Library (Spencer), where rare books, manuscripts, and archival collections are stored, staff spent significant time and efforts transporting supplies and collection materials between the main library lab and Spencer Library. Although it was only a seven- to ten-minute walk, the time added up when trips were made several times a day by multiple staff members. Transporting the most vulnerable materials made less and less sense as the relative volume of that work increased relative to the general collection workflows. In 2011 a workroom was established in Spencer Library in order to complete simple repairs on site for special collections and archives materials. KU Libraries purchased a laboratory freezer for mold and pest remediation for incoming collections, which was stored in the Spencer mailroom. In addition, a room was established in Spencer for taking digital images of conservation projects as part of treatment workflows. Slowly the conservation presence was increasing in the special collections and archives library, but it was spread among rooms on different floors and did not allow for full-scale conservation treatment, which still occurred in the main library laboratory.

In 2011, the department moved under the supervision of the assistant dean for distinctive collections, as part of a larger library realignment effort. The department was renamed Conservation Services and its activities expanded to include large-scale refurbishment and enclosure projects at Spencer Library. A separate unit in the Libraries was formed to focus on preserving audiovisual materials. The first mention of a new conservation lab occurred in 2011; staff could not know that it would take seven years to turn this desire into a reality, although the long lead time allowed for years of drawing up and revising plans. The identified space in Spencer Library was originally designed to contain forty-four small rooms to serve as auxiliary office space for campus faculty, comprising approximately 5,000 square feet, which had morphed into collection storage rooms around the year 2000. One exciting feature of the new space was six windows that would provide natural light for conservation treatments and joy for staff who had previously worked very much underground.

In 2016 the forty-four faculty offices in Spencer Library were demolished. Funds were not in place to build a lab at that point, but the large, open space was a boon for planning. Rather than having to visualize furniture placement in a computer program, staff used large pieces of paper, cut to the footprint of various pieces of equipment, and moved them around the open space. In addition, while planning the lab, conservators consulted with staff from other institutions who had recently developed their own conservation labs, incorporating many helpful suggestions about equipment and workflows. While some universities have hired a conservation laboratory consultant to plan their labs or sent their campus architects to visit other conservation labs for inspiration, such luxuries were not in this budget. The new conservation laboratory opened in July of 2018; the resulting space and equipment are described in the next section.

Another aspect of Conservation Services was greatly strengthened in 2016 when a trained audiovisual preservation specialist was hired, with a reporting line now in Conservation Services. This staff member would supervise preservation and digitization for audio, video, and moving image film formats. The one small space for audio preservation would not be sufficient, and KU Libraries investigated ways to expand the footprint of this operation, which is detailed later in this paper.

Library and Archives Conservation Lab

Literature Review

In the planning process for the book and paper laboratory, Conservation Services staff reviewed the literature of laboratory design, particularly for conservation laboratories. They investigated aspects such as workflow analysis, working with campus architects, redesigning and renovating existing spaces, designing new laboratories, and ergonomics in the workplace. The gold standard for anyone hoping to develop or update a lab, which covers all of these topics, is *Planning and Constructing Book and Paper Conservation Laboratories: A Guidebook* (Teper and Alstrom 2012). This seminal work features chapters, each penned by a different author, on various aspects of planning, from furniture, lighting, water systems, and quarantine rooms, to project management and floorplan design.

A few research library book conservation laboratories were built or updated not long before KU Libraries' lab project, and some conservators have shared their experiences with the professional community. For example, University of Washington (UW) conservator Justin Johnson discussed the development of UW's lab at an American Institute of Conservation meeting, which was reviewed in a blog post by Corkill (2017). Johnson noted that UW's renovation was fueled by the hope to increase the ability to work on intensive treatments on special collections materials, while also incorporating general collections workflows. UW partners designed a space that would incorporate the training of emerging professionals; incorporate book, paper, and photograph treatment in one space; and be flexible enough to be used for research and outreach. Johnson noted the importance of working closely with an architect, who is unlikely to previously have designed a conservation laboratory. In addition, in 2019 library conservators at three institutions presented a poster at the American Institute for Conservation annual meeting (Norman et al. 2019) about redesigning and renovating existing laboratory spaces at Pennsylvania State University, University of Maryland, and Emory University. Staff at Emory suggested that conservation staff "work with a space planner to envision the new lab creatively and without bias for the conservation profession" and staff at Maryland encouraged teams involved in renovation to "visit established labs and talk with colleagues about design" (Ibid).

Another useful resource is the recording of the 2016 Preservation Lecture Series symposium held at Yale University that featured four library and archives conservators who had designed new or renovated labs: Beth Doyle from Duke University, Eliza Gilligan at the University of Virginia, Jennifer Hain Teper at the University of Illinois Urbana-Champaign, and Christine McCarthy from Yale (Yale University Library 2016). The panelists provided useful details about their planning. All panelists tried to create open and flexible plans with as few built-ins as possible. Doyle recommended considering ergonomics when planning for work benches and office spaces. Teper indicated that a "dirty room," or quarantine space, has been important for her lab and she wished they had more space for those activities. Gilligan noted that the University of Virginia used the university vendor for science labs for various pieces of equipment, including work benches, to save money on state contracts. McCarthy stated that Yale's hybrid laboratory space for both general and special collections treatment was a "conscious decision after years of being segregated," as general collections staff possess transferrable skills that can be repurposed as workflows change. All panelists stressed the importance of reviewing workplace adjacencies in the design of the functional spaces. In addition to the hosting the symposium, Yale University Library impressively documented the planning and construction of its Gates Laboratory in a LibGuide online resource (Yale University Library 2019) that features pictures of its equipment space and a summary of its new lab and equipment (Yale University Library, Center for Preservation and Conservation 2019), as well as helpful links to other resources, such as the American Institute for Conservation's wiki page on "Setting up a Conservation Lab" (American Institute for Conservation 2020). Similarly, Duke University Libraries maintains a helpful Flickr page with images of the space and equipment of the Verne and Tanya Roberts Conservation Lab (Duke University Libraries 2020).

Another aspect to consider in planning a laboratory space is ergonomics. Heather Caldwell Kaufman's publications on ergonomics in conservation laboratory design are helpful in considering each piece of equipment and how it might be made more comfortable to use (Caldwell 2012; Kaufman 2003). The author addresses typical conservation workflows and how those actions might be made less taxing. She advocates for the use of anti-fatigue mats "with a double-thick (7/8 inch) sponge base" (Caldwell 2012: 134), waist-high wastebaskets that do not require bending over to use (2012: 138), and even considers equipment typical of book conservation labs, such as corner rounders and board creasers, that come with awkward foot levers to operate (2012: 135). Conservation staff also took to heart her focus on height-adjustability and modularity, in particular for height-adjustable work benches on wheels (Ibid).

Planning and Building Process

In a June 2014 brainstorming session about a possible new laboratory, Conservation Services staff shared their visions for the new space. High on the list was modularity.

The former KU Libraries conservation lab boasted built-in benches with lots of drawers. While the effect was stunning, the set-up lacked the possibility of arranging tables into different configurations to accommodate large or long items. In addition, the benches were too high or low for some staff to work comfortably. Staff hoped that tables on lockable wheels in the new lab would allow for different configurations of table arrangements for different purposes. In addition, height-adjustability was key, since benches in the old lab were not an ideal height for many lab employees, resulting in back injuries or use of stepstools. As Rowley and Hanthorn note, "a flexible floor plan offers definite advantages. Some equipment, by its nature, will be permanently placed: sinks, guillotine, and anything extremely heavy or hard-wired. But that list can surprisingly be kept rather short" (1996: 100).

In addition, staff hoped to improve the ability to perform more complex treatments with a larger, six-foot-wide fume hood and a six-foot-long washing sink with a water filtration system, preferably all within a separate space with its own door to follow university laboratory safety guidelines. Similarly, a quarantine room for dealing with dirty and moldy collections was essential. Finally, staff hoped that some underused equipment scattered across Spencer Library—such as the ultrasonic encapsulator, large mat cutter, photography equipment for photodocumentation, two map cases, and lab freezer—would be integrated into the new lab.

As planning progressed, staff reviewed and analyzed workflows in order to situate equipment and workbenches. Rowley and Hanthorn state that "by carefully planning adjacencies of functional areas within a treatment facility one achieves efficiencies in work patterns and space utilization thereby creating opportunities for controlling equipment costs" (1996: 100). General collections work involves more walking around, many book trucks, and a fleet of boisterous student employees. Conservation staff determined that some equipment was best placed near these workflows—such as the board shear, guillotine, two job backers, Colibri dustjacket protection machine, corner rounder, and floor stapler. In contrast, special collections work areas would be in hopefully quieter areas of the lab, farther from the door and student activities. Those staff members felt that their use of many of the large pieces of equipment, like the board shear, would be relatively less frequent.

The planning team consisted of conservation staff; the associate dean in charge of facilities; campus architects; campus environment, health, and safety personnel; and contractors and subcontractors. Conservation staff met regularly with the lead architect to design the quarantine room, wet lab, and office spaces; the main open laboratory space was designed by Conservation staff. This activity was in line with Conn's recommendation that while "the overall management will be the responsibility of the project manager . . . The conservator should ensure regular means of communication through scheduled meetings" (2012: 9). During the construction phase, the team met biweekly, and sometimes even weekly, for updates on the progress of the project from

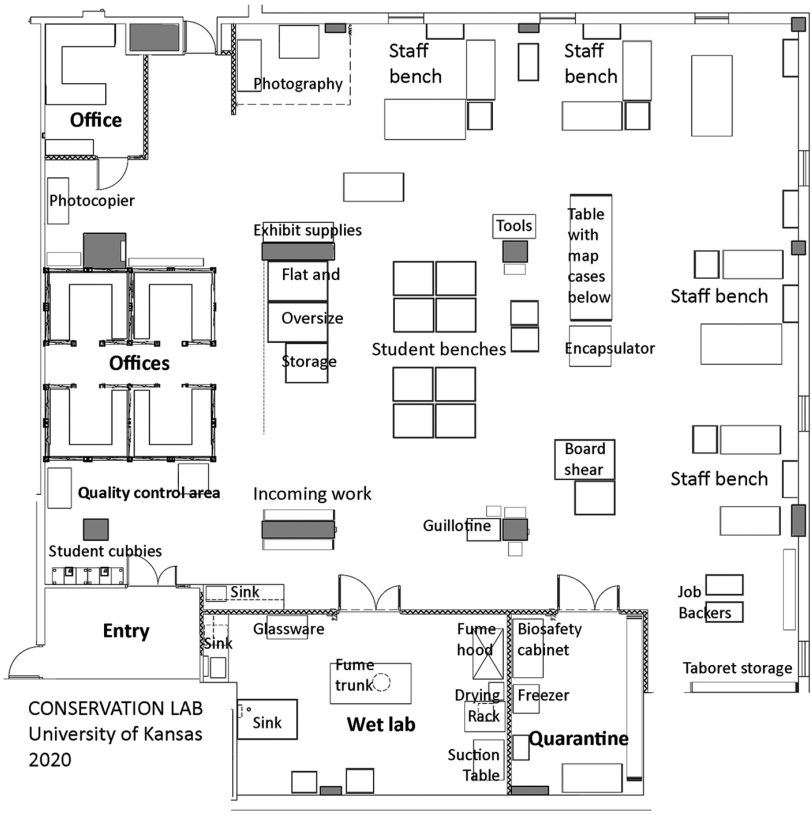

Figure 1. Conservation lab floorplan.

the contractors and subcontractors. Everyone stayed well-informed during the construction progress.

Wet lab. The new wet lab area, measuring around 500 square feet, allows for treatments involving water or other solvents. The area is enclosed, allowing Conservation to adhere to campus laboratory safety guidelines. Safety features, such as an eyewash on the washing-out sink, fume hood, and fume trunk, help to facilitate the proper use of chemicals. The hood and trunk were recycled from other labs on campus, saving many thousands of dollars. The new wet area is completely in compliance with campus laboratory safety practices, and all staff were trained on using the fume hood and water filtration system, as well as completing online laboratory safety classes (Figure 1).

In addition, the wet lab features a four-by-six-foot washing sink with tilting capabilities for drainage and some conservation treatments performed on a slant. The sink can be accessed from three sides, affording more flexibility in conservation treatment. The sink has a shelf below to store washing trays. Coupled with the sink is a high-end, laboratory-grade water purification system. One unit dispenses deionized water, and the second is a polisher to produce ultra-pure water. (See Appendix A for equipment details for the conservation lab.)

The wet laboratory also includes specific equipment for wet treatments, such as a four-by-four-foot drying rack that was custom-built for the former conservation lab. It was resting on a ledge in the old lab, so wheeled metal racks were purchased to place it at a good working height and allow the unit to be rolled around the space. In addition, the department's freestanding vacuum suction table and a large book press on a wheeled table are located in the space to accommodate many types of treatments. Glass-fronted cabinets contain laboratory glassware.

Quarantine/dirty room. Conservation and other staff in Spencer Library envisioned a resting place for incoming collections that may previously have been stored improperly or otherwise be at high risk for pest or mold contamination. Ideally, this 150-square-foot space would have been outside the conservation lab entirely in a sealed space or close to the front door in Conservation Services to avoid bringing compromised materials deep into the laboratory space. In actuality, however, the wet lab was instead located right by the door in order to take advantage of water pipes in the bathrooms directly outside the department. Administrators hoped to avoid extending water pipes far into the space, and placing at risk collections stored on the floor below the lab. Therefore, the quarantine room is situated further into the department than may be ideal for potentially compromised collections, but the room has a tight-fitting door to separate it from the main laboratory space.

The quarantine room includes a wall of shelves to store incoming collections; a three-by-six-foot, height-adjustable, wheeled table; a laboratory freezer for pest- and mold-compromised collections; and a six-foot-long biosafety cabinet. The cabinet features an internal, high-efficiency particulate air (HEPA) filtering system to trap very small particles, including mold spores. Once a box of moldy papers is frozen to stop active mold growth, the papers are brought to room temperature and each page is examined and vacuumed in the biosafety cabinet.

Office spaces. Staff hoped to create some sort of separation between public and private spaces, namely the office area. Each conservator has their own cubicle and the head of conservation has an enclosed office; an extra cubicle is used by interns and fellows. Individual office space separate from a lab bench is not common for conservators but has paid dividends for staff who greatly appreciate having a more quiet

Figure 2. Overall view of the conservation lab, looking northeast. Image taken July 2020 by author.

area for office activities away from the bustle of the main lab. Conservation staff were able to repurpose two large, floor-to-ceiling curtains original to Spencer Library. Mounted on a ceiling track, they serve as a separation between public and private spaces and hide the back side of oversized storage units that would otherwise be seen from the front door.

Conservation Services is also home to six to ten student employees and interns who arrive between university classes for their work shifts. Right inside the front door are cubbies for them to leave items they are not allowed to bring into the lab proper, such as their backpacks and cellular phones. The office side of the department also includes office files, a reference collection, and departmental printer/photocopier.

Main lab. The new laboratory space was outfitted with height-adjustable tables to serve as both staff and student benches (Figure 2). Each of the four staff work areas were outfitted with one three-by-six-foot table. Two staff have a second, three-by-six-foot table and the other two utilize a larger table, measuring four-by-eight feet, for their second bench. The selected staff tables were recommended by conservators who had recently opened new laboratories. The tables are a neutral gray in color, deemed

by Kaufman as "relatively comfortable to look at for long periods of time as it is neither too bright nor too dark" (2003: 2). The tables are height-adjustable over the range of thirty to forty-two inches and have four locking casters. They also have six electrical outlets per table with a cord long enough to plug into the wall. Thanks to the modularity of wheeled benches, each conservator has arranged their workspace differently. Additional tables in both the three-by-six-foot and four-by-eight-foot dimensions were ordered for use in the wet lab, quarantine room, and as swing table space in the main lab. In addition, to accompany the benches, conservation staff have ergonomic chairs with features recommended by Caldwell, including the ability to "adjust seat height, angle and depth back height, lumbar support, and footrest ring to the dimensions of the sitter" (2012: 137). Each staff work area also features a twenty-four-by-thirty-six-inch table, thirty inches high and on lockable casters with two shelves, to serve as a book press stand with storage below. These "press stands," made of steel with a maple top, are also located in the general collections work area and the wet lab.

Student employees also work at height-adjustable, wheeled tables on casters (adjustable over a height of thirty to forty-two inches). These tables measure three-by-four feet, have an almond-colored top, and are placed together into two groups of four. Each student employee can work near others but have their bench at a height that is most appropriate for them. An additional table of this size was ordered to place next to the board shear to extend the bed of the shear. Student employees sit on vinyl and mesh height-adjustable chairs with a footrest ring.

Conservation staff reused as much equipment as possible, such as the board shear, lab freezer, ultrasonic encapsulator, vacuum suction table, three map cases, seven book presses, three job backers, mat cutter, cloth storage racks, a photographic copy stand, card catalog cabinet for tool storage, and some metal cabinets for auxiliary storage. An eleven-foot-long white Formica countertop was reused as a swing workspace and mounted on two banks of map cases previously owned by the department. The map cases store work in progress, papers, and polyester. The ultrasonic encapsulator is placed at the end of this long work table so there is a place to put encapsulation work in progress. The encapsulator sits on a four-by-four-foot, custom, height-adjustable, wheeled table, allowing for access to three sides of the previously underused machine. The encapsulator receives frequent use now that the placement and configuration make it possible. In addition, two sets of repurposed metal laboratory cabinets were turned into an area for exhibition supplies, with a Formica countertop placed on top as a resting place for a large mat cutter. A similar countertop was bought for a previously-owned metal laboratory cabinet now placed in the wet lab.

Staff took several approaches to compensate for loss of storage previously found in built-in work benches with many drawers. To store small tools, each staff and student employee was provided with a small rolling cabinet (called a taboret) that has four

drawers and an open top shelf, with a cut-out handle for steering. Students store their taborets in a corner of the lab under shelving that was designed to start a few inches above the height of the taborets. Each staff member has a taboret in their work area. In addition, the Libraries' shelving contractor designed metal cabinetry for each staff area (plus two extra) that feature pull-out shelves on the bottom and enclosed shelves above. Staff store work in progress and larger tools in these cabinets. Shelving was also added to some sides of structural columns throughout the lab space.

For supply storage, conservation staff designed flat, oversized shelving measuring four-by-six feet for storage of board and rolled materials. These shelves can be accessed from both the front side, facing the lab, and the back side, which faces the office area and is usually covered by curtains. Cloth storage racks consisting of metal rods suspended in a slotted wooden case were brought from the old lab and reused to store book cloth and other wovens. An additional repurposed map case near the student employee area stores papers, boards, and foam, plus flat work in progress for the student employees. Finally, a repurposed wooden card catalog cabinet stores small common tools in its various drawers.

An area for photodocumentation (digital imaging of library materials before, after, and sometimes during conservation treatment) was created in one corner of the lab. The area features a copy stand, a wheeled table used with a freestanding backdrop, and various photography lights. The area can be enclosed by a black photography curtain on a ceiling track and has a separate light switch from the main lab. When not in use, the curtains are pushed over to the wall to open up the space. The area is painted a neutral gray, following recommendations provided by Schieszer, who blogged about setting up a conservation photodocumentation space at the shared conservation lab for the Public Library of Cincinnati and Hamilton County and the University of Cincinnati (Schieszer 2014).

Because the space once contained many small faculty studies, there were ample electrical wall outlets, but none in the center of the room. Six pull-down electrical cords, with four outlets each, were installed in the space: five in the main lab and one in the wet lab. Each staff bench has a task light on wheels that can plug into the back of a bench. The overall laboratory has motion sensor lighting to save energy when the space is not being used, and the photodocumentation, wet lab, quarantine, and the head conservator's office have independent light switches to control lighting in those auxiliary spaces. The six windows are covered with ultraviolet-filtering film.

Analysis and Lessons Learned

Overall, the planning and construction of the new conservation laboratory proceeded smoothly. The extremely organized contractor and architects provided regular updates on construction status, describing any unforeseen delays and answering questions

from conservation staff. For example, a few pieces of equipment were delayed in construction and delivery, and the team worked together to plan moving-in around these inevitable delays. The architect, library staff, and main contractor attended all the meetings, and were joined by subcontractors like electricians, when appropriate. Conservation staff appreciated being fully informed on the building process and contractors enjoyed learning about and working on an unusual type of project. The head of conservation kept extensive spreadsheets to plan for ordering of tables, shelving, chairs, and other equipment, keeping track of items, quantities, type, dimensions, colors, costs, vendors, links, notes, special requirements, and order and receipt dates.

The new space has been ideal in many ways. For one, conservation staff have found that previously underused equipment is frequently employed now that there is adequate space to spread out. In addition, while the curators rarely visited the old lab, they now stop by regularly, making discussions about conservation treatment much easier, collaborative, and more timely. The new construction included upgrades following campus laboratory safety and Americans with Disability Act (ADA) requirements, making the space safer for everyone who might work there. Finally, the laboratory always hosted regular tours and training sessions, but these opportunities have greatly increased in the new space, which is much more impressive and accommodates many more people. When a tour group was expected in the old lab, valuable bench space was used to set up examples for the tour; now there is space to set up an example table without affecting regular conservation treatment workflows. As a result, some entire university class sessions have been taught in the new laboratory.

In the summer and fall of 2020, when staff returned to work on staggered schedules in the wake of COVID-19 workplace adjustments, the new conservation lab fully lived up to its potential. Buttons to open doors to the quarantine room and wet lab, originally installed to meet ADA requirements, operated just as effectively with an elbow instead of a hand push. The availability of hand-washing sinks within the lab cut down on opening the main lab door and interacting with staff in other parts of the building. In addition, tables were moved into new configurations to provide ample distance between student workers, who previously worked at tight clusters of four tables. The ample floorplan allowed for new modular configurations to easily maintain social distance.

There have not been many downsides, to date, with the new conservation lab. One challenge is that a large, open space allows noise to carry well. The curtain separating the main lab from the office area does not damper sound very effectively. When many people are working at once, and often listening to music, it is occasionally quite boisterous and sometimes difficult to concentrate on exacting work. Overall, the new conservation lab has more than met expectations; in fact, the seven years' lead time resulted in such exacting planning that it has exceeded even our wildest expectations. It is a joy to work in such a thoughtfully designed space.

Audiovisual Preservation Labs

Literature Review

Unlike the conservation laboratory construction literature, there is very little published information about establishing and constructing spaces for audiovisual preservation. Most of what exists takes the form of more ephemeral publications, such as blogs or conference presentation summaries. For those works that exist, the focus is more typically on equipment and software specifications, not workflows or ergonomics, although what's been written for book and paper laboratories could also largely apply to audiovisual set-up. An institution aspiring to create an audiovisual preservation program would have to rely not only on the literature but especially on direct conversations with preservation professionals who have established programs in their workplaces. Fortunately, there are a few institutions that have published equipment and software specifications for their laboratories, such as the Stanford University Media Lab, which has listed online (1) the equipment in its labs for audio and video preservation (2020a) and (2) supported audio, video, and film formats (2020b). The University of California, Santa Barbara Library has likewise published a description of the equipment in the Henri Temianka Audio Preservation Labs (2010–2019). Dale et al. published the findings of an American Library Association Task Force in 1998, with case studies of six audio laboratories at the end of the report (1998).

Audio. For those just getting started, a first general guide is the *ARSC Guide to Audio Preservation* published by the Association for Recorded Sound Collections, Council on Library and Information Resources, and National Recording Preservation Board of the Library of Congress. This publication describes and includes photographs of various types of audio recordings, including the rare or unusual; descriptions of typical deterioration; and notes on playback. It also includes cleaning advice, format-specific storage guidelines, and a discussion of various pieces of playback equipment. It is not too specific, but may serve as a general guide for those just starting or with only surface knowledge (Brylawski et al. 2015). Another useful resource for beginners, with an overview of workflows, procedures, and equipment, is Cocciolo's *Moving Image and Sound Collections for Archivists* (2017).

Casey and Gordon discuss the space requirements for audio preservation: a "critical listening" room with "an ambient noise level well below that of the quietest sound we wish to audition when listening at a safe, comfortable, non-fatiguing playback level." In addition, Iraci et al. from the Canadian Conservation Institute (2012) provide real-world advice for setting up an audio lab, recommending "any quiet, separate room that provides for a substantial degree of sound absorption (with carpet on the floor, acoustical tiles on the ceiling, soft office divider panels and wall-hung sound absorbers)." They also discuss how to secure good-quality playback equipment, given that most is

obsolete and potentially challenging to locate, and provide helpful advice on how to connect the equipment.

On the subject of audio reformatting operations, Kovac and Love discuss the establishment of the audio lab for the National Archives and Records Administration. This space was created to support "playback in many formats, most of which are obsolete and no longer supported, [including] analog open reel tape, audio cassette, Sound Scribers, Gray Autograph discs, wire recordings, DAT tapes, and transcription discs from various periods and construction" (2015: 21). Their article provides an overview of the development of the audio lab and how they use batch derivative software to speed processes, but does not provide specifics on equipment or software.

Video. For an in-house video preservation and reformatting operation, one useful source is the work of the XRF Collective, which provides online guidelines for its video digitization workflows, with descriptions of equipment used, photographs of how to connect the various pieces of equipment, and diagrams of cables. There are also pictures to aid in cleaning a variety of video deck heads and calibrating pieces of equipment for a video digitization rack (XRF Collective 2020). In addition, various resources that were handed out at the 2017 Association for Moving Image Archivists meeting by the Audiovisual Preservation Exchange (APEX), and later posted to the Github site for technology developers, include a video kit diagram with pictures of the various components for video digitization (2017a); a list of video kit elements (2017b); and "A Starter's Guide to Video Digitization" (2017c) that outlines the main steps in the process. Likewise, a 2017 blog post by Rowe discusses in detail the process of setting up a video rack for Iowa State University Libraries. She notes that finding equipment to play obsolete video equipment can be a challenge. As she states, "prepare to spend some time digging around online or contacting potential dealers to find a functioning playback device . . . You need well-maintained, industry-grade equipment with as much related documentation as possible." Rowe provides specific details about cabling, capture cards, software, and various pieces of equipment used to digitize video from a U-Matic tape deck, one of the pieces of equipment that will be standard for most university video labs. She includes a helpful list of all the equipment and associated pieces required for this process (Rowe 2017).

Kovac and Love have published on the video laboratories at the National Archives, in addition to the audio labs referenced above. They note that video lab staff spent significant time researching preservation and access file formats, and standards for digital preservation. The staff built several in-house video workstations and also "installed a robotic digitization system capable of digitizing the 3/4 U-matic tape format" (2015: 21). Kovac and Love list the many video formats supported by the

video lab and note that staff also "spend much time prepping, cleaning, and repairing video media for safe and transparent playback for digital capture" (2015: 22).

Finally, on the topic of refurbishing obsolete equipment, Villereal discusses a project that required him to reach out to former employees of a cable television station, including a retired video energy engineer who helped document problems with equipment. Villereal was also able to contact a current video engineer to help rebuild a piece of equipment. He notes the importance of local contacts for knowledge about legacy technologies when developing in-house reformatting operations (2014: 53). In a similar vein, Angeletti (2014) reports on turning to retired experts to educate staff about obsolete equipment and aid in their refurbishment.

Planning and Building Process

In 2005 a preservation librarian was hired who was particularly interested in audiovisual collections and broadened the Preservation Department's scope to include those materials. In March 2011, her duties were refined to focus full-time on audiovisual preservation efforts, in a department distinct from Conservation Services. She established an audio preservation and digitization room in the basement of Spencer Library, located far from other library workers, so audio formats could be played out loud in real time. Casey and Gordon note that an ideal audio lab should be "free from ambient noise, it must be removed from other work areas and traffic, and its acoustic weaknesses should be well understood" (Casey and Gordon 2007). The KU Libraries audio lab was superb in this sense, but was small and contained the original 1968 carpet and paint. In 2016, the first audiovisual preservation specialist was hired, with the task of expanding preservation efforts beyond audio into video and moving image film.

A workroom that had been used by conservators to perform simple, onsite treatments and housing projects in Spencer Library was converted into a space for film and video inspection, with the hope of someday incorporating video digitization. The space was sufficiently roomy to accommodate these workflows, and the Steenbeck flatbed moving image film editor, a large piece of equipment that had been housed inconveniently in the library's reading room two floors above, could be reunited with the audiovisual operations. The audiovisual preservation specialist hoped to make a few changes to improve the space, including adding independently controlled banks of lights; moving wall electrical outlets to table height rather than near the floor; and adding electrical outlets to the center of the room. Finally, the audiovisual preservation specialist hoped for storage space for supplies and work in progress.

In the fall of 2018, spaces for audio and video/film preservation were refurbished, and a storage room in between was outfitted with more plentiful and better shelving

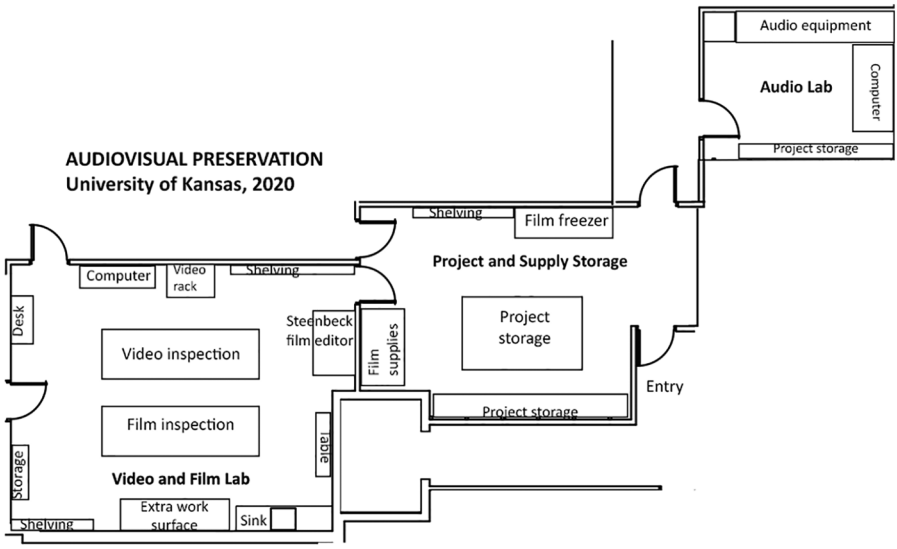

Figure 3. Audiovisual labs floorplan

(Figure 3). The planning team for this three-month project included the audiovisual preservation specialist, the associate dean for facilities, the campus architect, and campus facilities staff, who worked together to determine how the rooms needed to be adapted for their new uses, as well as what equipment belonged where.

Audio. In the 200-square-foot audio digitization lab, the first step was for the AV staff to remove all equipment, tables, and shelving. As the audiovisual preservation specialist noted in a Spencer Library blog post about the updates, "my team of student workers and I devised a strategy of labeling all of the cords and ports on our pieces of equipment so that disassembly and re-assembly would go quickly" (Bañuelos 2019). The 1960s carpet was removed and replaced with luxury vinyl tile and the walls were painted. Upgraded light-emitting diode (LED) lighting on a dimmer switch was added to more appropriately illuminate the space. Staff determined the best locations for new, table-height electrical outlets. While this work was in progress, the audiovisual preservation specialist chose tables from the former conservation lab that would match one another and provide the best functionality for the new work space. The reinstalled equipment includes analog playback equipment for preservation winding, housing, and digitization of various audio formats, including an LP turntable, audio cassette and mini cassette players, compact disc (CD) player, and reel-to-reel player (see Appendix

Figure 4. View of audio lab. Image taken July 2020 by author.

B for equipment details). The equipment also includes a CD polisher, LP cleaning device, and solvent storage cabinet. The back wall of the space includes a large desk with computers and speakers for digitization, and one long wall contains shelving for supplies and work in progress (Figure 4). The audio room is tucked away from other activities, to allow for playback in real time without bothering other staff. It is also in an area removed from any electrical rooms or the elevator, both of which could interfere with the digitization and transfer of the audio signal.

Video and film. There are two banks of tables in the center of the 622-square-foot room that houses video and moving image film operations: one for video inspection and the other for film inspection and preservation winding. Electrical outlets were added to the ceiling in the center of the room to allow for computer and machine access at those tables. A section of oversize shelving that was on the wall immediately to the left inside the door was relocated to the other side of the wall, in the storage space area, to house archival film canisters. Removing the shelving from inside the film and video room allowed space to place the bulky Steenbeck moving image film editor (used to watch and listen to motion picture film in order to gather metadata). Near the right of the door, a range of shelving was shortened but retained in order to make space for a video rack

Figure 5. View of video and film lab. Image taken July 2020 by author.

(containing various video playback devices and other pieces of equipment required for the digitization process), as well as a computer desk with equipment for digitization.

Moving image film digitization equipment is prohibitively expensive to acquire and maintain, so that work is sent to vendors and completed off-site. However, there are many steps accomplished in-house. Staff and students gather metadata for proper cataloging of moving image films, work which often requires the use of the Steenbeck flatbed film editor. The screen on this piece of equipment is easier to view in low light levels; so the addition of updated LED lighting "to allow for independent control of lights in the front of the room as well as the back" was crucial in effectively using the space (Bañuelos 2019). Student employees inspect the film for problems, rewind it following preservation standards, and house it in conservation-grade enclosures. Films are then permanently stored in KU Libraries' high-density storage facility that has a special film vault with a low temperature and relative humidity appropriate for such materials. The video and film lab also includes more shelving and table space for back-up equipment near the back of the room (Figure 5).

Finally, a 450-square-foot room outside the video and film lab was converted to storage for work in progress and supplies. As mentioned above, one wall contains oversize shelving for film preservation supply storage. Another long wall contains boxes of films as part of the film winding workflows. The opposite wall contains

additional shelving and a chest freezer to store films displaying vinegar syndrome, a deterioration mechanism of materials like film made from cellulose acetate. Freezing deteriorated cellulose acetate film will retard this chemical reaction. Deep, free-standing shelving was repurposed from the old conservation lab and placed near the center of the room to house boxes of audiovisual materials in progress.

Analysis and Lessons Learned

While overall the upgrades and renovated spaces well meet the needs of audiovisual preservation staff, there are a few areas that could use additional attention. For example, although there were significant additions of electrical outlets, they have been required in greater abundance than expected. As the audiovisual preservation specialist notes, "I accounted for all of the equipment we have and allowed for extra plugs, but there is always some new piece of equipment that needs to be plugged in" (Chris Bañuelos, email message to author, May 4, 2020). In addition, upon reflection, he feels that the sink in the video/film lab, which was not removed during renovation, is less useful than additional storage space in that area would have been. In particular, he would appreciate more space for storing equipment not currently in use. Likewise, additional table space in the audio lab for inspecting materials would be helpful, although the size of the room does not allow for it.

Workflow analysis is ongoing in the video/film space. Spencer Library staff often pass through the room in order to access a collections storage space behind the lab. These interruptions sometimes happen at inopportune times for reformatting workflows, but that problem is not solvable at the present time. Overall, the video/film space is meeting current needs: Bañuelos states that once the video rack is fully operational, the "current configuration of tables and equipment is the best we can do" (Chris Bañuelos, email message to author, May 4, 2020).

On the positive side, renovations in the audio lab, including a floor that is easy to clean and electrical outlets at table height, have been extremely helpful in professionalizing the work in that space. In addition, the storage and staging room that is located between the two labs has been extremely helpful for staying organized and keeping work in progress at hand and together. The new setup allows staff to track progress and fix mistakes when necessary without spending time going back and forth to the collections stacks. Overall, the renovations have increased productivity and efficiency for audiovisual preservation staff.

Conclusion

Conservation Services staff were extremely fortunate to be integral to the process of planning and designing functional and beautiful work spaces. With plenty of lead time to assess workflows, review the literature, consult with colleagues who have

undertaken similar renovation and upgrade projects, and dream for what might just be possible, KU Libraries staff successfully upgraded preservation spaces in Spencer Library; created a greater sense of camaraderie among Conservation Services staff; and improved the efficiency and efficacy of the resulting preservation and conservation production.

Appendix A: Equipment Sources, Book, and Paper Conservation Lab

Work Stations

Staff benches and encapsulator table: Formaspace
Student benches: All Metal Designs, Inc.
Book press tables: Global Industrial shop stands
Staff lab chairs: Hàg (Capisco, saddle seat)

Wet Lab and Quarantine

Treatment sink: Willard, custom-made, four-by-six-feet, with hand-operated tilting mechanism for drainage
Fume hood: Labconco, six feet long
Biosaftety cabinet: Fisher Scientific: six feet long
Biosafety chair: Fisher Scientific, adjustable with vinyl seat and back (no mesh or cloth products should be in a quarantine room)

Storage

Shelving, including oversize flat: Southwest Solutions Spacesaver
Taborets: TrippNT

Appendix B: Equipment Sources, Audiovisual Lab

Audio

Turntables

REK-O-KUT CVS-16 DD restoration deck
Pioneer PL 3000 DD full auto turntable
Dual 1219

Receivers

Sansui 1000X
Advent 300

Open reel tape decks
Ampex ATR 700
Akai 4000 DS MKII (3 head, 1 μm gap)
TeacX1000R
Ampex ATR 700
Revox B77 MK 11 2 Channel 1/4 IN Audio Recorder
Otari MX 5050 2 Channel 1/4 IN Audio Recorder
Ampex 4 Channel 1/4 IN Audio Recorder with (4) VU Meters
Sony (TC 580) w/auto reverse, bi-directional recording, and 3 moto servo control

Cassette decks
Nakamichi CR-7 cassette
Tascam 122 cassette

Miscellaneous equipment
Keith Monks Record Cleaning Machine
RTI Eco-Smart Disk Repair System
RTI Tape Check 160 Series
HP 400 EL AC Voltmeter
APC Battery Backup

Video

Video decks in rack
Sony PVW-2800 Betacam SP
Sony BVU-950 U-Matic SP (2)
Panasonic PV-8451 VCR+
Sony DSR-1800 DVCAM

Extra video decks
Sony U-Matic SP VO-9600
Sony U-Matic V0-5800
Sony U-Matic VP-7020
Sony VO-9850 U-Matic SP
Sony DVD/VCR SLV-D300P
Emerson VCR EV598

Monitors
Sony PVM-14M2U Trinitron Color Video Monitor
Sony PVM-14M2U Trinitron Color Video Monitor

Other video digitization equipment
Ocean Matrix PSW-24 High Performance Passive Router (audio/video switcher)
DPS-290 Component TBC/Synchronizer
Leader Waveform Monitor 5860C/NTSC Vectorscope 5850C
Blackmagic Mini Converter Sync Generator
Blackmagic Intensity Shuttle
Channel Master CM-3414 4-Port HDTV Signal Amplifier
Neutrik NYS-SPP-L1 audio patch panel
ADC—PPI-22224RS video patchbay

Film
Steenbeck flatbed editor
16 mm film rewinds
Adjustable 8 mm/16 mm/35 mm film rewinds
16 mm guillotine film splicers
35 mm guillotine film splicer
Film loupes and gauge rulers
16 mm frame counter

Throughout Labs
Macintosh computers with Adobe Creative Suite

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