

High-Density Off-Site Storage in North American Research Libraries

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Abstract

Limited space for new building and soaring construction costs have prevented many American research libraries from constructing significant on-campus bookstack additions. At the same time, faculty and student demands for networked information have required libraries to become information technology gateways. Space once designated for bookstacks has been converted to accommodate computer workstations and instructional activities.

One strategy to open library space is to move rarely used collections off site. Currently, twenty-two ARL libraries operate environmentally-controlled, high-density remote storage facilities. The University of Colorado's facility was opened in 2001 and has the capacity to house nearly one and a half million items in only 880 square meters by shelving books by size on eight-meter tall shelving. Because the facility is thirty-six kilometers from campus, materials are retrieved upon patrons' electronic requests and are delivered to the library daily.

Such storage facilities provide the foundation for renovation of existing on-campus library buildings for twenty-first century services. High-density off-site storage permits valuable on-campus space to be repurposed for high-demand services. With millions of volumes being moved off site, many research libraries will soon have significant portions of their collections in storage, transforming them from just-in-case storage into just-in-time delivery of bound research materials.

Keywords

High-Density Shelving, Off-Site Storage, Research Libraries, Space Use

Introduction

North America's 124 Association of Research Libraries (ARL) member libraries added nearly ten million volumes to their collections in 2001-2002—enough materials to occupy 360 kilometers of shelves [1]. Yet even among the handful of ARL libraries that undertook construction projects during the 1990s, few added significant bookshelf space on which to store the growing print collections. Obtaining space for construction has become competitive and contentious as many universities have a shortage of on-campus construction space. In many cases, universities have chosen to construct

classrooms or laboratories rather than library bookstacks. This has forced library administrators to think creatively about materials storage. While campus priorities often preclude construction of bookstack space, patron demand favors service areas such as wired group work and study spaces as well as teaching laboratories. To accommodate the demand for information technology, even new library construction often contains fewer bookstacks than the original building. Instead, they choose to reduce footprints for traditional shelving to open vast areas of library floor space for collaborative study space and information technology. Computer jacks and workstations proliferate in space once reserved for bookstacks. To accommodate this shift from bookstacks to seats with network jacks, millions of seldom-used volumes are being removed from library shelves for storage in off-campus facilities.

While libraries have adopted different models for off-campus book storage high-density storage facilities are becoming the preferred choice, at least within the ARL, with more than two dozen of the facilities opening in the past fifteen years [2]. The dynamics of campus space constraints, high construction costs, and the changing nature of patron usage of libraries have encouraged this new model of off-campus storage with on-demand delivery. High-density storage facilities store volumes arranged by size on unusually tall shelving rather than sequentially by call number in traditional library stacks. By storing materials by size rather than call number, space efficiencies of more than seven times are realized when compared to traditional shelving. This significantly reduces land, construction, and operating costs. Rather than constructing storage facilities on university campuses, the buildings are erected kilometers away sometimes in warehouse districts.

PASCAL Justification

Harvard University designed and opened the first high-density storage facility in 1986. PASCAL (The Preservation and Access Services Center for Colorado Academic Libraries), Colorado's high-density storage facility based on the Harvard model, was first proposed in 1997. PASCAL, like the Harvard facility, houses seldom-used volumes efficiently in a climate controlled off-site environment. Stored materials are available by on-line request from patrons through the library catalog [3]. The plan was approved by the University of Colorado Regents and then by the Colorado Commission of Higher Education in 1998 with funding of four million one hundred thousand dollars.

In the program plan, the University of Colorado argued for additional bookstacks and that high-density storage was the most practical solution. In 1997, library construction (excluding land cost) was estimated to be \$280 per gross square foot on the University of Colorado at Boulder campus [4]. Consequently, the cost to build on-campus bookstacks for five hundred thousand volumes (the equivalent of five years of growth at the University of Colorado) would be nearly seventeen million dollars. The cost to construct high-density off-site storage for one and a half million volumes, is only four million one hundred thousand dollars. This represents construction costs of \$219 per gross square foot. While the cost per gross square foot is similar to

that of on-campus construction, the efficiency of high-density storage is more than seven times that of conventional construction.

The University of Colorado had gone so far as to lease traditional warehouse space off-campus, but that was proving to be an inefficient use of funds. Three hundred thousand volumes had been moved from the main library in 1997 to a building nineteen kilometers from campus. The building was an open-plan warehouse with minimal environmental controls. Three-meter tall shelving was used and materials were shelved in call number order for easy locating for retrieval. Courier trips were made daily to pick-up materials requested through the online catalog. While this proved effective for a relatively small number of materials, it was not financially scalable. In 1998, it cost an average of one dollar per item annually to store it in the traditional warehouse [5]. With a need to store over a million volumes, costs could exceed a million dollars annually using such a model. Cost analysis of a high-density storage facility demonstrated that it would be approximately twenty-five percent the cost of traditional warehousing. This proved to be a compelling argument for constructing PASCAL.

Facility Description

Opened in November of 2000, the facility is thirty-six kilometers from the Boulder campus in north east Denver. PASCAL consists of three separate areas: a patron reading area, the processing area, and the storage module [Illustration 1]. The entire facility's footprint measures 1,765 square meters. The processing area contains 362 square meters; the storage module about 882 square meters; and the reading rooms about 100 square meters. The remaining space consists of offices, shared spaces, loading facilities, and mechanical rooms.

PASCAL has a capacity of approximately one and a half million volumes in only 1,765 square meters in its single storage bay. Traditional shelving would require a footprint of 6,100 square meters to store the same number of volumes. The master space plan allows for the future construction of up to four additional storage modules, bringing the total capacity to 7.5 million volumes. The additional modules can be constructed as needed and will have a single connection that permits access between each module. The single processing area will accommodate the workload of additional modules without expansion.

Although PASCAL is intended to be a delivery facility, it does contain patron reading rooms. Users may come to the facility to view large runs of periodical volumes or microforms without having to make numerous successive retrieval requests. Patrons may use materials on-site by appointment, and microform readers, photocopiers, and internet jacks are provided in the reading rooms.

Storage Module

The footprint of the storage module is approximately eight meters by sixty-five meters with an eleven-meter-high ceiling. Within the module are four aisles of nine-meter-high, fifty-five-meter-long rows of custom-designed shelving. While most of the storage efficiency is accomplished by shelving books on the tall stacks rather than on traditional stacks, further efficiency of space is gained by sorting volumes by size rather than by call number. Incoming materials are sorted according to height and depth with similarly sized items placed in one of five sizes of acid-free paperboard trays corresponding to the most commonly occurring sizes of books. Storing like-sized materials together increases shelving efficiency by another fifteen percent.

One consequence of storing by size, however, is that the Library of Congress subject classification order is disregarded. This requires that a new location code be assigned to every volume transferred into PASCAL. Every book transferred to PASCAL is already labeled with a barcode that relates to an item record in the Innovative Interfaces, Inc. on-line circulation system. As books are processed at PASCAL, staff affixes a second barcode and record the number into the appropriate item record. Encoded within the second barcode number is the permanent location of the book in the storage module. Based on the barcode number alone, the operator can retrieve or reshelv any of the items in the storage module [Illustration 2].

Because of the unusually tall shelving, items are retrieved by using an order selection vehicle custom-built by Caterpillar. This battery-powered forklift has been modified by adding a stainless-steel platform on which an operator stands. From the platform, the operator can control forward and backward motion of the vehicle as well as raise the platform to a maximum height of eight meters. The order selection vehicle is driven to the shelving section of the requested item, and then the platform is raised to the proper height. The operator removes the tray from the shelf and selects the requested item by matching the title from a printed request form. After circulating, materials are returned to PASCAL and reshelved in the trays in which they were originally housed using the same barcode number as their unique address.

PASCAL Environmental Controls

The storage module provides a state-of-the-art preservation environment for materials. The module has been designed to achieve twice the insulation value, six times the air tightness, and fifteen times the vapor barrier of standard construction. The air-handling system is computer controlled to adjust gradually the storage module's temperature to be thirteen degrees Celsius and thirty-five percent relative humidity regardless of seasonal changes. This eliminates any rapid fluctuations in the environment that might damage the materials over time. A recent study estimates the lifespan of paper-based materials to be less than thirty years when stored in the typical library environment of twenty-two degrees Celsius and fifty percent relative humidity. Predicted lifespan increases to 160 years when materials are stored in fifty-five degrees Fahrenheit and thirty-five percent relative humidity [6].

Patron Requesting and Materials Retrieval

An on-line catalog record for each item informs patrons that the item is stored in a remote location, and items are typically requested by the patron directly through the online catalog. Regular courier deliveries bring requested materials to campus [7]. Patrons may place requests for PASCAL materials directly through any of the four participating libraries' on-line catalogs. Requests may also be placed in person at the circulation desks. Prior to each delivery, PASCAL staff generates and prints a list of requested materials through a search of the on-line catalog. PASCAL staff does not currently photocopy journal article requests. Instead, journal volumes are delivered to patrons for photocopying at their convenience.

Discussion

Moving to a delivery model for research collections from an on-site shelving model offers compelling advantages to libraries. It opens valuable library space for heavily used computer workstations and bibliographic instruction spaces at a time when construction of additional bookstacks space is often impractical. Off-site storage of seldom-used materials can even strengthen the on-site print collection. Margaret K. Powell has argued that off-site storage offers security and preservation for older materials. Removal of materials, if judiciously pursued, can leave the on-site collection more coherent and better suited for browsing [8]. Some libraries have even reported that undergraduate users prefer to have materials delivered rather than having to retrieve items from the stacks [9]. Dan Hazen has pointed out that materials removed for off-site storage—particularly for high-density facilities—must have complete on-line catalog records. Consequently, research collections that have remained uncataloged for decades are now being cataloged in the on-line catalog with bibliographic records in order to support searching and retrieval once they are moved off site [10].

Regardless of the physical space opened for new and heavily-used services, some academics wonder about the consequences of moving research collections off-site. The least circulated materials, as humanities and social sciences faculty frequently point out, are the research materials necessary for meticulous scholarship. The very strength of an academic library, these faculty argue, are the extensive holdings of seldom-used research materials. Relegating such materials to a remote location—one that precludes browsing of the collection—undermines the mission of a research library. Robert S. Seeds, a mathematics librarian, agrees that the disassembly of a collection eliminates the ability to browse by rational associations that classified shelving was created to encourage. Electronic shelflists, Seeds contends, are not an adequate substitute for browsing as they do not contain sufficient content description for a researcher to identify needed information. Because the on-site collection no longer represents the discipline's body of knowledge, or even what the institution selected to collect, the unsophisticated researcher may even be misled into false conclusions about the literature. Moreover, waiting for delivery of stored materials can stall momentum. Researchers can lose their thought process while waiting for delivery of requested materials, particularly if successive requests must be initiated [11].

Conclusion

With millions of volumes moving off-site, many academic libraries will soon have significant portions of their collections in storage. Campus pressures for space have prevented libraries from constructing significant bookstacks additions while developments in book-storage techniques have encouraged off-campus storage. At the same time, faculty and student demands for networked information have required libraries to become high-technology gateways, and space once designated for bookstacks has been reserved for computer workstations.

Cost-efficient off-site storage facilities will increasingly transform North American academic libraries from just-in-case storage into just-in-time delivery of research materials. Moving rarely used materials offsite opens valuable library floor space for high-demand services such as instruction and computer workstations. However, there remains a significant challenge to create a technical infrastructure that can transmit sufficient content information through the on-line catalog to researchers so as not to frustrate or stall the research process.

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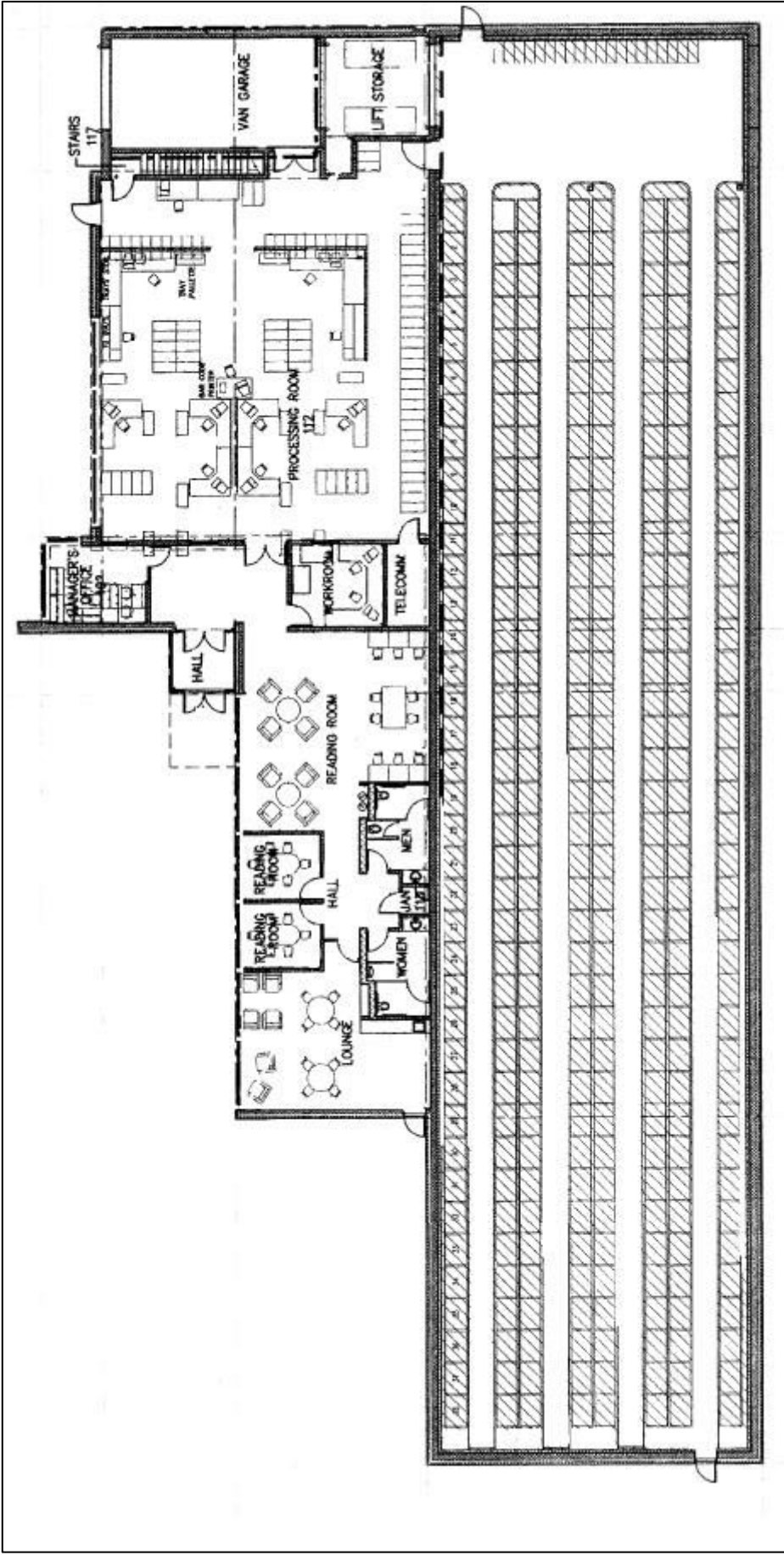


Illustration 1: Preservation and Access Service Center for Colorado Academic Libraries floor plan.

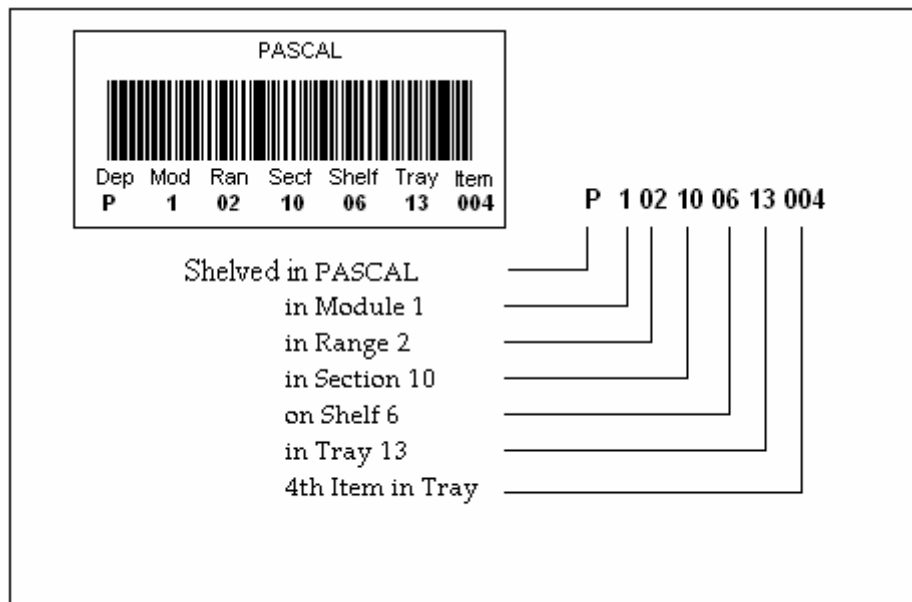


Illustration 2: Preservation and Access Service Center for Colorado Academic Libraries (PASCAL) barcode.