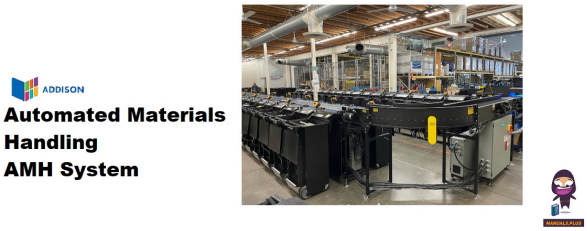

ADDISON Automated Materials Handling AMH System Instructions

Contents

ADDISON Automated Materials Handling AMH System

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- **Abstract**: – Modern libraries must keep pace with the continuously changing technological environment which often requires rethinking and re-organizing entire library facilities as a prerequisite condition for upgrading or changing traditional patterns of providing user service. The implementation and utilization of Automated Material Handling Systems (AMHS) facilities significantly increases the efficiency of library collection storing and handling while enhancing archives productivity and performance. This paper provides a presentation of the structure and operation of the AMH System along with a case study at the University Library and City Archives of Bergen, Norway.
- **Key-Words**: – Automated Material Handling Systems, AMHS, Automated Storage and return/sorting, AS/AR, compact shelving, radio-frequency identification, RFID.

Introduction

Automated materials handling refers to the management of material processing by use of automated machinery and electronic equipment. In addition to increasing the efficiency and speed by which materials are produced, shipped, stored, and handled automated materials handling reduces the need for humans to do all of the work manually. This can significantly cut down on costs, human error or injury, and lost hours when human workers need heavy tools to perform certain aspects of work or are unable to perform the work physically. Some examples of commonly used automated materials handling processes include robotics in manufacturing and toxic environments; computerized inventory systems; scanning, counting, and sorting machinery; and shipping and receiving equipment. These resources allow humans to perform work faster, safer, and with less need for additional personnel to manage routine tasks and time-consuming aspects of producing goods from raw materials [1].

Carousel usage ranges from file storage in an office to automated materials handling in a warehouse. Following the success of the automated warehouse, libraries have begun to adopt automated storage system technology. Library planning historically has involved the organization and protection of collection storage space to allow ready access to users and easy serviceability by staff. Collection storage is still one of the principal space uses of libraries, even if electronic media and online access to information have changed the nature of information storage and retrieval. Traditional book stacks can occupy over 50% of a library’s space and are still the preferred method of collection storage and access for high-use material. Efficient space planning of stack areas is an essential design objective to minimize the building cost impact.

The high cost of building construction has led to the development of alternative materials storage and handling systems in modern library buildings, especially for collection items that have lower demand or special space needs, which utilize high-density storage techniques. These systems eliminate significant amounts of building floor area normally required to house the collection. Movable shelving systems eliminate much of the space usually given over to walking aisles, while new types of automated systems compact the storage volume, reducing the size of the building even more significantly [2].

Compact Shelving Storage

These High-Density or Movable Aisle Compact Shelving (MAC shelving) storage systems feature bookcases or cabinets of various configurations that move along tracks. When closed, the shelving is very close together and a great deal of space is saved. In each section of shelving, only one aisle is open between ranges at any one time as shown in Fig. 1. Most of the materials will be shielded from light most of the time. The mechanism that moves the shelving can be powered by electricity or cranked by hand. Compact Shelving has been in use for several decades, and the design has been refined to eliminate the same problems of the past. The hand-cranked mechanisms are much smoother than in earlier models and ranges move quite easily [3].

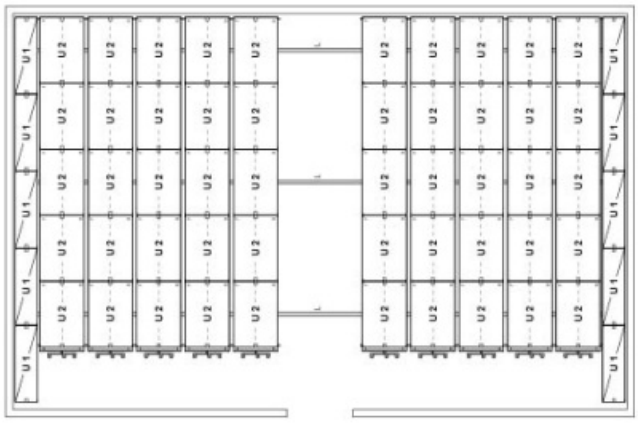

Fig. 1. Compact Shelving Installation with single accessible aisle

Compact shelving units are available with either a manual or an electrically-operated chassis and with safety devices that cause the movement of the carriage to stop immediately if it makes contact with an object (for example, a book that may have fallen into the aisle), a book truck or a person.

Automated Storage and Retrieval Systems AS/RS

Automated Storage and Retrieval Systems is an advanced material handling equipment using the concepts of high-density storage of items with a computer-controlled stacker crane handling the item was developed. Systems typically consist of 4 main components:

1. the storage rack (this structural entity comprises storage locations, bays, rows, etc.),
2. the input/output system,
3. The storage and retrieval (S/R) machine, used to move items in and out of inventory. An S/R machine is generally capable of both horizontal and vertical movement. In the case of fixed-aisle storage systems, a rail system along the floor guides the machine along the

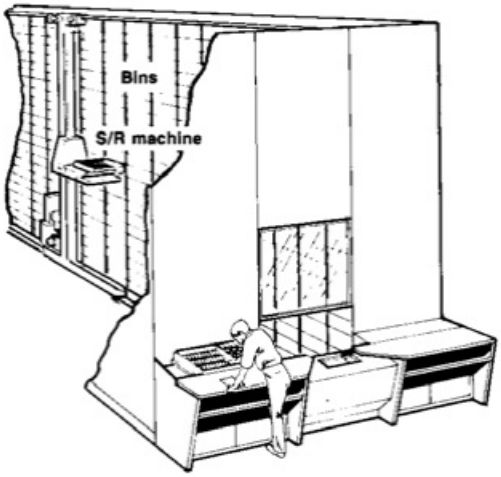

Fig. 2. AS/RS System Components

aisle and a parallel rail at the top of the storage structure is used to maintain its alignment.

4. The computer management system. The AS/RS computer system records the bin location of each item in the collection and maintains a complete record of all transactions and the movement of the items over time. Systems of this nature have been used for years in manufacturing and warehouse facilities.

The characteristics of such warehouses include

- high-density storage (in some cases, large, high-rise rack structure)
- automated handling systems (such as elevators, storage and retrieval carousels, and conveyors)
- materials tracking systems (using optical or magnetic sensors) [4].

  For large libraries and archives with collection materials that are not necessarily accessed daily, such as large government document collections, back periodicalss or even portions of fiction or nonfiction collections, an automated storage and retrieval system (AS/RS) may be a feasible and cost-effective approach to collection storage. Such systems have been installed in several academic libraries, and have reduced the amount of floor area required for collection storage significantly below that required even for compact shelving. The cost of the automated equipment and storage structure is generally offset by the savings resulting from the reduced size of the building.

The operational advantages of AS/RS technology over manual systems include:

- reduced errors,
- improved inventory control, and
- lower storage costs [5].

Automated Return/Sorting Systems

Return /sorting systems – the library community's term for what are called "conveyor/sorting systems" in the industry – move materials from the point of return to sorting equipment that can scan barcodes or RFID tags to ascertain which of several bins, and totes, trolleys (carts that accommodate a single stack that can be tilted at any one of several angles), or special book trucks an item should be dropped. While there are scores of manufacturers of such systems for warehouses, libraries have been most interested in companies that also offer book drops or patron self-service discharge units that front-end the conveyor to reduce handling and that interface with an integrated library system for automated check-in and the re-activating of security tags [6]. RFID is a powerful tool for automating returns in a way that was never possible previously. Basic AMH functions are quite simple and

generally fall into one of two categories: conveyance of containers and automated sorting. Sorting sites considering AMH are usually most interested in sorting functions.

In the first category, robotic craness or cart systems have beedesigninggn to convey totes at the central sort site. Some of these systems move incoming totes to the sorting system location in the facility to eliminate any manual lifting of the totes. This same system then takes totes that have been filled in the sorting process away from the sorting system location, organizes them according to routes, and delivers them to a loading dock area ready for truck loading and delivery.

In another type of material transport system, materials are stored in carts or wheeled bins that also serve as the containers used to take the materials to and from libraries. Materials in the sorting system are placed into Smart Bins, which, after they have been filled, are then simply rolled onto trucks with lift gates for delivery to libraries. Both systems are designed to ease the physical transfer of materials within a central sort site and delivery routes.

The sorting system itself, which redistributes incoming materials at the central sort site to their respective library destinations, is typically a belt-driven system with the ability to read bar codes or radio-frequency identification (RFID) tags, communicate with the integrated library system (ILS) shared catalog automation software, and place item in a particular library's tote or bin ready for transport. The first part of this system is the induction point, where materials to be sorted are placed into the system, typically onto a conveyor belt. This can be done either manually or by specialized induction equipment. Once an item is on the conveyor belt, its bar code or

RFID tag is scanned by a reader. The reader then connects to the automated catalog to determine where to ship the item. After this information is received by the sorting system, the item travels along the conveyor belt until it reaches the designated library's chute. The belt system is often set up with what is called a cross-belt, which grabs the item and sends it through a chute into a tote or bin for the library. The system can be programmed to have items sorted d several ways. Many sorting systems are programmed to have two

Fig. 3. Return/Sorting System

chute locations for each library, so that hold items go into one chute and return to the other [7]. The greatest benefit of return/sorting systems is the reduction in ongoing operating costs as the result of a significant reduction in the handling of returned items by library staff. Staff members do not have to empty book drops, move materials, check them in, re-activate the security tags, or place them in bins or totes, or onto trolleys or special book trucks. Anecdotal evidence suggests that the initial investment can be recovered in reduced labor costs in as few as four years. However, most libraries utilize the savings by redeploying library staff to direct customer service. Another benefit is that materials are ready more quickly for reshelving, thus increasing the availability of materials. Finally, the use of return/sorting systems reduces the incidence of repetitive motion injuries for staff [6].

Automated Material Handling Systems (AMHS) – Case Study: University of Bergen Library and City Archives of Bergen, Norway

University of Bergen Library

This case study is the result of the authors' mobility period at the University of Bergen Library in the frame of Leonardo da Vinci – Procedure A – Mobility Project RO/2005/95006/EX – 2005-2006 – "Migration,

Emulation and Durable Encoding" – Forming experts in document management software, backup and restoration of documents, techniques for emulation programming, and XML text format with application on old and rare books 01-14.Sept. 2006. In August 2005, the University Library of Bergen was modernized and reopened as the Arts and Humanities Library.

Fig. 4. Compact shelving storage with electrical system

On this occasion, it has adopted, for the warehouse, a compact shelving storage system that rides on moveable carriages over floor-installed rails. The rails can be either surface mounted or set in the concrete when the slab is poured. Compact shelving units are available with both manual and electrically operated chassis and with safety devices that cause the movement of the carriage to stop if it makes contact with an object (book truck) or a human.

Electrical systems move the ranges automatically by the press of a button and are suitable for large lengths of ranges or large overall arrays. The electrical installation and motors add about a 25% premium to the cost of the system. The benefit of compact shelving is that the system maximizes the use of floor space by having only one access aisle, which can be relocated by moving the carriage-mounted cantilevered metal shelving to open an access aisle at a desired location. Depending on the design of the installation, the elimination of fixed aisles can reduce the overall amount of space required to house the entire collection to one-half or even one-third of the area that would be required for a fixed-shelving installation.

In new constructions, compact shelving provides a dense storage system that reduces the size of the building, resulting in a net lower total cost for housing the collection. Most libraries can utilize compact shelving for sizable portions of the collection and can take advantage of the resulting space savings [2]. It is important to note that when a library or archive is planning a renovated building, every effort should be made to include a modern heating, ventilation, and air conditioning system (HVAC) designed for the needs oflibrariess or archives. It should have the capacity to provide constant relative humidity and moderate temperature in storage spaces, 24 hours a day, 365 days a year. HVAC systems include filters capable of removing various particulate and gaseous pollutants.

Fig. 5. HVAC System

Also during the modernization University Library of Bergen has adopted the RFID system as a new technology for:

- circulations and
- enhanced book security.

RFID and Automated Materials Handling Systems are being built into modern libraries to reduce the cost of handling books. Customers return items via an RFID-enabled sluice chamber system, with a touch screen interface listing the returned items and guiding the patron through the process. The returns chamber only accepts items recognized as being part of the library's collection. Once the items are returned the patron receives a printed receipt on request. The returns chute is designed to accept small, thin, large ,and thick items, as well as small audio cassettes and CDs/DVDs.

Fig. 6. Book return automat.
The front, where books are returned

Returned items pass into the Book Return Sorting System – a system of interconnected modules that identify each item and recognize where it needs to go.

Fig. 7. Behind the wall.
Transportation line with automatic
sorting of books

There are no restrictions on how many modules can be combined as each has its microcontroller. This enables libraries to enlarge, reduce, or modify a system at any time. Available modules include sweep sorters and roller sorters, which can work together in the same sorting line. Roller sort modules are designed with a small diameter and close arrangement to safely sort and transport small, large, thick, k, or thin items. Quality components allow high-speed processing of up to 1800 items an hour, while the noise level remains at an ultra-quiet 55dB. The system identifies each item, directing it to the docking station and appropriate sorting bin ready for distribution within the library or transportation to the item's home library. Sorting bins are available with either a spring-controlled bottom plate that adjusts to the applied weight or an electronically controlled bottom plate for automatic height adjustment when staff are unloading [8].

City Archives of Bergen

The AS/RS is a highly dense storage system for library materials that evolved from automated materials handling systems used in manufacturing operations. In the case of libraries and archives, the collection items, identified by a standard bar code system, are stored safely in large metal bins that are placed in a large steel structural rack system. Collection items requested by a patron are picked from the storage array by large mechanical "cranes" that travel in an aisle between two tall structures holding the storage bins as shown in Fig. 8.

Fig.8. AS/RS Crane

The cranes deliver the bin rapidly to a staff workstation, where the collection items requested are removed from the bin, recorded as removed, and placed into one of the transport systems for delivery to the Circulation Desk area. The amount of time required from the moment of the patron's order from any library network access location to the arrival of the item at the Circulation Desk is usually a matter of minutes and is referred to as the throughput time.

Returned items are handled in reverse, with the items being delivered after returns processing via the internal transport system to the staff workstation at the AS/RS. A bin with available space is fetched from the storage array by the crane and the item is placed in this bin after its storage location is recorded in the computer system as is

shown in Fig.9. The collection items stored in the AS/RS are obviously not “browsable”, except electronically and at whatever level of “user friendliness” is designed into the electronic browser. However, the speed of the system transaction renders it ideal for material that is not frequently accessed, making the search and securing of the desired item remarkably fast for the patron.

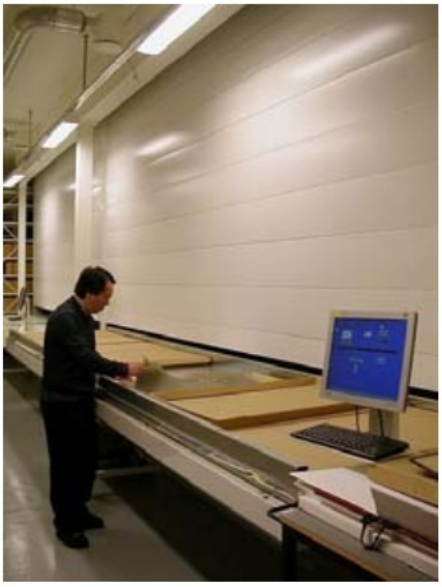

Fig. 9. Computer System

City Archives of Bergen use AS/RS especially for the preservation and conservation of technical documents, and maps with atypical dimensions but not only. All warehouses are equipped with compact shelves, with sensors or manual, and are located in a new building erected on the site of the city’s former beer brewery, inside a mountain. The archive was designed and built between two highway tunnels that run through the mountain assuring the highest safety conditions. Beginning in the year 1996 this archive was developed based on a program focused on decisions about the structure and layout of the warehousetoo to be able to take over and process archives from public installations and private citizens.

Conclusion

Automated Materials Handling is a space-saving system that combines self-service check-in with automated sorting for quicker return of your materials to the stacks. It improves service for libraries and archives patrons and makes work easier for its staff by simplifying the return process. This technology eliminates much of the time that was spent accepting items at the front desk and clearing patrons’ records, so circulation staff can devote more time to serving patrons.

Some of the ain benefits from ofementing RFID, especially at the item level are productivity, improved collection management, reduced risk of injuries, and enhanced customer service. Patrons enjoy a better library experience with simplified processes and shorter lines. RFID also frees up library staff time (e.g. from scanning each item for checkout) to focus on more value-added activities.

The library benefits of RFID technology can be classified as follows:

Benefits to library management

- Efficient collection management system (can be located suitably and made 24×7);
- Labor-saving methods free the staff to help customers;
- Flexible staff schedules;
- Higher customer/patron satisfaction levels;
- Better preservation of inventory because of less handling by staff;

- Uncompromised security within the library;
- Uncompromised collection security;
- Same security and labeling formats for all items such as books, CDs, and DVDs, hence better management of databases;
- Improved inter-library cooperation.

Benefits for library staff

- Time-saving devices free them to help customers better;
- Labor-saving devices free them from doing repetitive, physically stressful tasks;
- Can have flexible working schedules.

Benefits for library patrons

- Self-check-in and self-check-out facilities;
- Check-in and check-out of all types of items (books, audio tapes, videotapes, CDs, DVDs, etc.) at the same locations;
- More staff available for assistance;
- Quicker service such as payment of fees, fines, etc.;
- Better inter-library facilities, more efficient reservation facilities, etc.;
- Faster and accurate re-shelving means patrons can find items where they should be, hence quicker and more satisfying service;
- Height-adjustable self-check-in/out tables are liked by children and physically disabled persons who use the library [9].

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Specifications

- **Date Issued**: September 12, 2024
- **Vendor Questions Submission Deadline**: October 1, 2024, at 9 am CDT
- **Response Due Date**: October 15, 2024, at 12 pm CDT

Frequently Asked Questions

Q: Who is responsible for providing the dumb drops?
A: The responsibility for providing both exterior and internal dumb drops lies with the vendor.

Q: Can the OSHA Certification be installed?
A: Yes, the OSHA Certification can be obtained after the installation of the AMH system.

Q: Will the drive-up be staffed?
A: Yes, the drive-up service will be staffed.

Documents / Resources

	ADDISON Automated Materials Handling AMH System [pdf] Instructions Automated Materials Handling AMH System, Materials Handling AMH System, Handling AMH System

References

- User Manual