Warehousing Books: A High-Density Storage Library in Action

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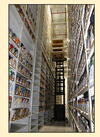


Introduction

About Severn Library

- Severn Library is an off-site, high-density storage library at the University of Maryland College Park.
- It was built in a former Washington Post printing facility in 2015-2016.
- The off-site storage collection was stored at Johns Hopkins University's Library Services Center from 2005-2016. The collection was moved into Severn Library in June 2016. Severn Library staff began circulating books in October 2016.

About High-Density Library Storage

- Began at Harvard University Library in 1986
- Preserves materials and increase density, which ultimately saves money and space in circulating libraries.
- Includes:
  - Storage of materials by size
  - Use of acid-free trays to store materials
  - Items are accessed by barcode
  - Use of an inventory control system to store collections metadata and control operations
  - Use an order picker to access 30 foot high shelving
  - Controlled climate of 50°-60°F and 35%-50% relative humidity (RH)

About Warehousing

In warehouses, productivity is the most important metric, with the goal of *productivity* equaling as close to 1 as possible.

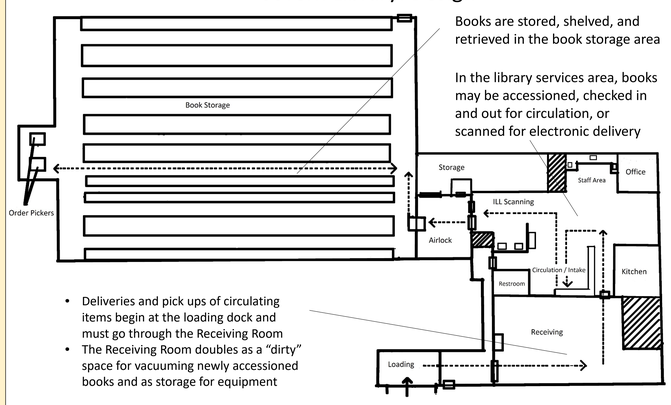
$$Productivity = \frac{Units\ picked}{Person\ hours}$$

Warehouses have many different uses and designs. The type closest to high-density storage is Orderpicking, which means that one person picks specific orders from the shelves.

Severn Library: By the Numbers

565,879 books	•There are 565,879 books in Severn Library--all items from the University Libraries' collection)
1.25M books / 40k boxes	•When full, Severn will hold 1,250,000 books and 40,000 archival boxes
10.5 miles of shelving	•There are 55,370 linear feet (or 10.5 miles) of shelving in Severn
30 foot high shelving	•The shelves in Severn are 30 feet high
$3.40/book savings	•Shelving a book in high-density storage saves the Libraries approximately $3.40/book each year! •A book kept in the open stacks cost $4.26 per book per year, while a book kept exclusively in high density storage costs $0.86 per book per year
50.8˚F / 32% RH	•The book storage area is kept at 50.8˚F & 32% RH for the preservation of the books.
2.5 staff	•1.5FTE operate the library and circulate material, plus a project specialist

Severn Library: Design



Books are stored, shelved, and retrieved in the book storage area

In the library services area, books may be accessioned, checked in and out for circulation, or scanned for electronic delivery

- Deliveries and pick ups of circulating items begin at the loading dock and must go through the Receiving Room
- The Receiving Room doubles as a "dirty" space for vacuuming newly accessioned books and as storage for equipment

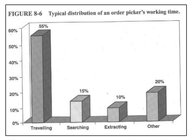
Best Practices in Warehouses: Storage

Consideration	Warehouse Best Practices	Severn Practice
Scale	Keep an order grouped at the largest scale possible (ex. by the truckload or the pallet)	Severn staff receive individual items and sort them into trays, which are then grouped on shelves.
Density	Materials should be located to maximize storage efficiency	Trays and boxes are shelved on the shortest possible shelves
Productivity	Materials should be located to maximize operating productivity	• The lightest materials (A trays) are stored at the top of the modules • Archival boxes are at the bottom of the modules • The heaviest materials are located so that the staff member can use the orderpicker to position his/herself so the item is at waist height, which is ideal for quickly and safely picking up items

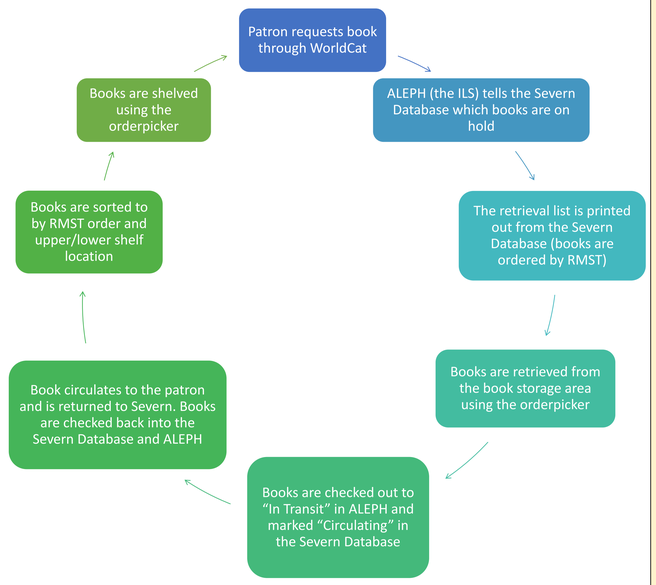
Severn Library: Circulation, Retrieval, and Shelving

Upper and lower shelves

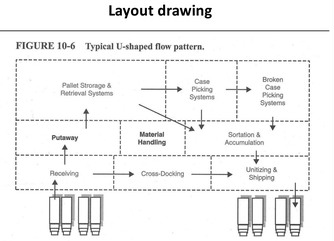
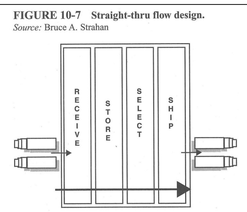
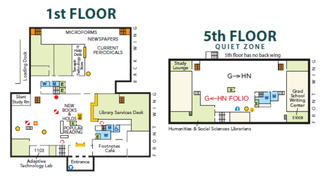
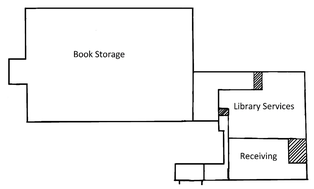
An Orderpicker



Travel on the orderpicker is time-consuming



Best Practices in Warehouses: Design

Design Name	Type of Facility	Description	Layout drawing
U-Shaped	warehouse	The processing and shipping areas are in an efficient arrangement with the storage areas	
Straight-Thru	warehouse	The layout models the sequences of the flow of items (Receive→Store→ Select→Ship)	
McKeldin Library	Circulating Library	Library services are centralized and located separately from book storage	
Severn Library	High-Density Storage Library	Library services are centralized and located separately from book storage; receiving and processing areas were set up with an efficient flow	

Severn Library: High Density Storage

In high-density storage, books are kept in trays and are not browsable. Each book in Severn is assigned to a tray, where it sits on the shelf. The RMST number is the tray's location on the shelf

R	M	S	T
Row is one side of an aisle There are 14 rows.	**Module** is one bookcase section There are 29 modules/row	**Shelf** is one shelf There are 30 shelves/modules	**Tray** is one cardboard box A: 16 trays B: 14 trays C: 12 trays D: 10 trays E: 12 trays

Best Practices in Warehouses: Shelving and Retrieval

Consideration	Warehouse Best Practices	Severn Practice
Automated Storage/Retrieval Systems	Use a robotic shelving system where the materials will come to the operator rather than the operator going to the shelf to get the materials	Impossible at Severn: • We have already committed to the human-mediated model • We are small compared to warehouses • EXPENSIVE to install
Batch retrieval and shelving	Materials should be retrieved from and returned to their various locations at one time, rather than one order at a time	We batch retrieval and shelving: • Retrieval: once per day in a batch • Shelving: two to three times per week in a batch
Sequenced retrieval and shelving (RMST order)	Materials should be sorted into size and location before they are returned to or pulled from their location	We sequence shelving and retrieving by RMST order: • The Severn Database sorts materials for retrieval • Severn staff sorts materials for shelving
Sequenced retrieval and shelving (upper then lower shelves)	Materials from the upper shelves of the modules should be pulled separately from the lower shelves	We sequence shelving and retrieving by upper and lower shelves: • Severn staff sorts materials before for shelving and retrieval

Conclusions

Severn Library is generally a very efficient warehousing operation, when compared to the operations laid out by Frazelle:

- Design
  - The design is not very efficient. Having one centralized library services area requires extra sets and is makes the design more similar to a circulating library than a warehouse.
  - Having the "dirty" space for vacuuming in-coming materials, equipment storage space, and receiving space to all be in the same large room is not ideal. While this set up maximizes the space, it also has the potential to get everything dusty. Since most of the materials coming in at this point require vacuuming, they would go through that space anyway.
- Storage
  - Severn Library's storage principles generally follow the guidelines set out for warehousing, making them very efficient.
  - High-density storage by its very nature turns the warehouse's fundamental rule for efficiency in storage on its head. Instead of keeping materials at the largest scale possible, we store individual items together in trays, which is why off-site storage is more efficient storage at its foundation than storage at a circulating library.
  - In order to further improve operational efficiency, we could store the least-used items at top-most shelves. However, since we are constrained to placing the lightest items at the top, we would have to place both the lightest and least-used items at the top.
- Shelving and Retrieval
  - Severn Library's storage and shelving and retrieval systems are as efficient as they possibly could be. The University of Maryland is not going to install an AS/RS system at Severn, therefore the human-mediated retrieval and shelving must be as productive as possible. Through this research, it has become clear that our methods are very efficient and we can use the tools at our disposal to support these efficient methods.
  - One way to make retrieval more efficient is to work with the systems administrator to reformat the retrieval list to display items on the upper shelves separately from those on the lower shelves.

Acknowledgements

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References and Credits

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Charlotte Johnson drew the Severn Library Design.
Rebecca Wilson took all pictures and created the McKeldin Library Design.