Update: R&D Project for fire Protection in High Density Storage Facilities

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Project Start

January 2005

- American Library Association panel discussion on high density storage/shelving facilities
  - Tom Schneiter, Harvard University
  - Janet Gertz, Columbia University
  - Tom Gaitley, Copper Harbor Consulting, Inc.

HD Library Facility Compared to Warehouse

HD Library Facility	Warehouse
•Solid shelves spaced 12”-18” apart	•Open rack shelving
•Narrow aisles due to size of materials being retrieved	•Large, open aisles to facilitate palletized delivery & retrieval
•Long-term, homogeneous collections	•Short-term, ever-changing materials

Archive/Library HD vs Warehouse

Project Development

- June 2005
  - Informal gathering of preservation librarians to determine next steps

    Columbia University
    Harvard University
    Library of Congress
    University of Chicago
    University of Michigan
    Yale University
    University of Illinois-Urbana Champaign

  - The informal gathering has since become an informal consortium

Survey Results

- Identified 51 institutions with high density facilities
- Survey conducted February 2006; 51% responded
- Questions asked regarding:
  - Type of facility
  - Environmental conditions
  - Age of facility
  - Construction details regarding the roof, exterior & interior walls and overall size with regards to length, height, width
  - Tier/shelving configuration
  - What was stored in the facility and how stored
  - Sprinkler/fire suppression systems

Survey Results

Facility construction dates ranged from 1976 to 2005

Construction for most were reinforced concrete with concrete panels or concrete block for exterior walls

Size of facilities

- Length—longest 330’; shortest 65’; 35% between 191-214’
- Width—widest 166’; narrowest 36’; 45% between 50-62’
- Ceiling height—tallest 85’; shortest 16’; 67% between 35-45’
- Aisle width—widest 96”; narrowest 30”; 55% between 46-54”

Survey Results

What is stored and how

- Bound items directly on shelf 68%
- Mss & archival collections, non-plastic containers 88%
- Analog audio disks, mechanical recordings, non-plastic containers 54%
- Microfilm/fiche, non-plastic containers 47%
- Magnetic media in trays on shelf 67%
- Oversize maps & drawings in flat files & shelves 56%

Survey Results

Storage within the a module

- Interfile format types within a module 54%
- Mixed formats within a section of shelving, the shelf, or within the range/aisle >33%

Fire Suppression systems

- In-rack sprinklers 50%
- No in-rack sprinklers 50%

Next Steps

July 2006 meeting at Yale to discuss:

- Survey results
- Goals, & expected outcomes of project

FM Global conducts an internal review to justify the project

- May 2007 approved
- October 2007 project started in earnest
  - David Fuller, Engineering Hazards
  - Kristin Jamison, Research Engineer

Where We are Now

February 2008 meeting at Harvard

- Lessons Learned from variety of tests already run
- Establishing the Test Plan
  - Goals & testing variables to consider
  - Potential testing
  - Performance criteria
  - Test plan summary
- Developing a timeline for the project

Lessons Learned from Past Tests

- Limiting vertical and horizontal flame spread is vital;
- Narrow aisles promote fire spread or “jump” via radiant ignition;
- Once a fire jumps, the intensity of fire on the jumped side soon matches or exceeds the intensity of the fire on the ignition side unless pre-wetting from sprinklers has occurred;
- Ceiling only protection, if adequate, is likely to save the building from destruction, but may not protect the materials within. Additional wetting from in-rack/face sprinklers aids in reducing fire damage to materials.

Overarching Goals

- Provide fire protection options for narrow aisle, high bay rack storage of books, archive boxes, and electronic media for a typical high density storage arrangement

- Develop loss mitigation methods to reduce non-thermal damage imposed on commodity during a controlled fire or water release

Subsequent Goals

If necessary, make recommendations for the future design of high density storage modules

- (e.g. maximum ceiling/storage height, strategic organization of collection , physical location and construction of building, HVAC systems, storage height vs. aisle width, container types, etc.)

Streamline protection and recovery process

- Assess current system and make recommendations aimed at reducing unneeded elements and emphasizing critical elements

Real World & Fire Test Variables

80+ VARIABLES IN ANY LARGE SCALE FIRE TEST

- Ceiling Height & Storage Height
- Clearance: distance from top of storage to ceiling level sprinklers
- Flue Spaces: longitudinal and lateral vs. longitudinal only
- Shelving:
  - open vs. solid vs. perforated
  - shelf height, orientation in rack (i.e. staggered)
- Vertical Barriers
- Material Type (e.g. books, archive boxes, plastic film, electronic media, flat storage)
- Tray Type (e.g. corrugated box, plastic, metal, wood); open vs. closed
- Ignition Location/Scenario
- Sprinklers
  - Ceiling, In-Rack, and Face
  - Temperature Rating
  - K-Factor
  - Spacing/Location
  - Response (RTI)
  - Density

Potential Testing Scheme

- Modeling (computer)
  - of limited use and used in conjunction with other tests
- Small Scale Testing
  - supplement the modeling
- Intermediate Scale Testing
  - materials/storage classification
- Large Scale Test
  - done only after analyzing results from earlier tests

Performance Criteria

- Amount of materials lost
- Number of sprinklers activated
- Damage to structure/building
- Amount/type of smoke generated

Test Plan Summary

- Start small and progress to larger test arrays as needed
- Construct tests that isolate specific variables and their impact on fire damage, such as:
  - Solid vs. Perforated Shelves
  - Location of in-rack sprinklers
  - Open vs. Closed flue spaces
- Develop practical recovery strategies that can be incorporated into a facility emergency plan

Timeline

- 2008

  Develop proposal and gather materials

- 2009

  Conduct testing

- 2010

  Publication of results

Much appreciation to David Fuller, Kristin Jamison & Mary Breighner at FMGlobal; Tom Gaitley at Copper Harbor Consulting, Inc; and fellow consortium members on this project.

Thank you

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