

# Low Oxygen Fire Suppression at the British Library

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# Low Oxygen Fire Suppression at the British Library

- The British Library
- ASP: an archive for the 21<sup>st</sup> Century
- Fire protection in UK archives: the received wisdom
- Why sprinklers wouldn't work
- Benefits of Low Oxygen ...
- ... and why it's not for everyone
- Risk, Cost, Environment
- Implementation

# The British Library at St Pancras, London



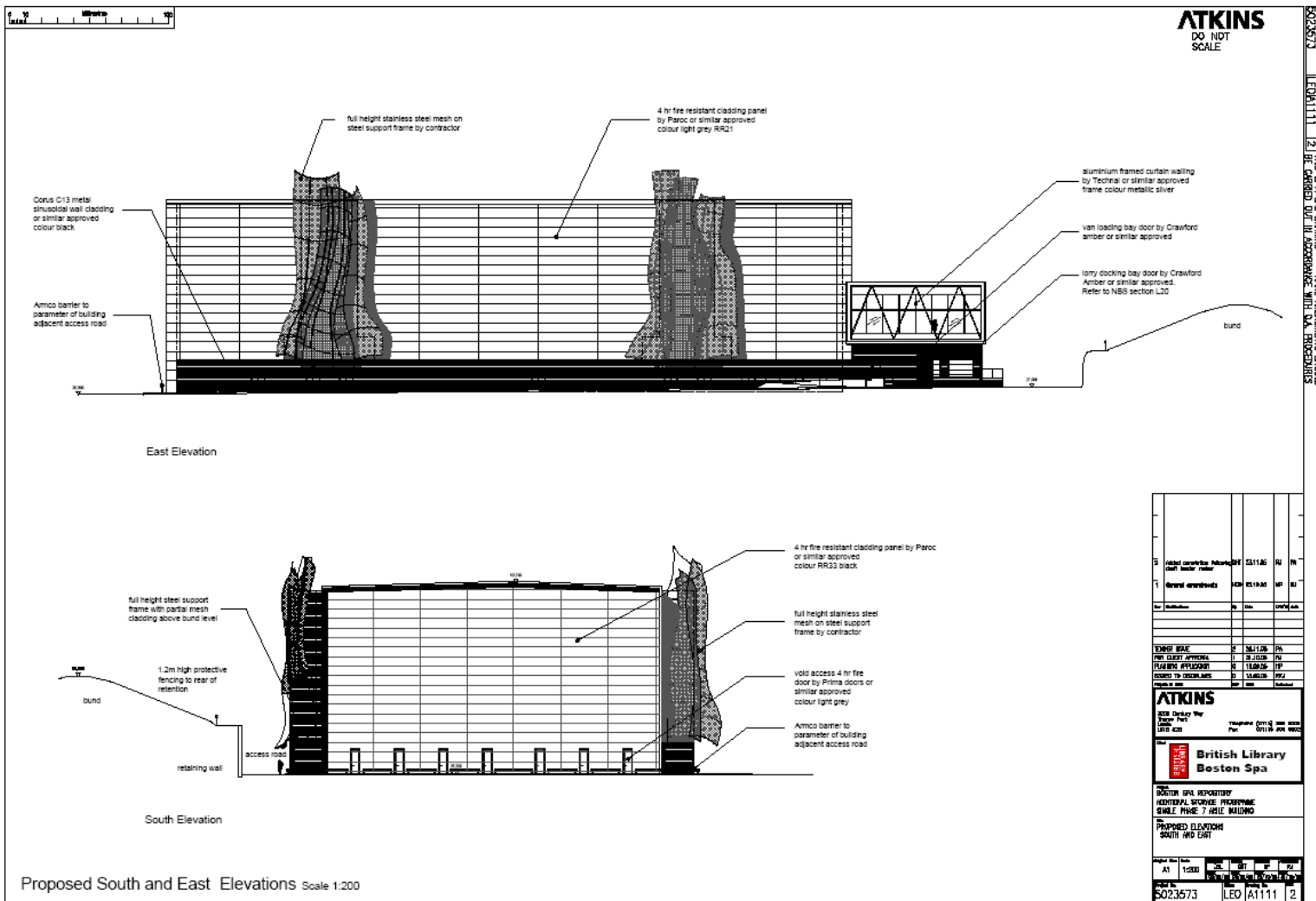
## Collections

- National library of the United Kingdom
- Preserve British written heritage
- We hold collections dating back to 300 BC, in all written languages, from all over the world
- We receive a copy of every publication produced in the UK and the Republic of Ireland
- Currently, storage amounts to 470 miles of shelving
- 3 million new items are incorporated every year requiring an additional 7.8 miles of shelving

## Additional Storage Programme (ASP)

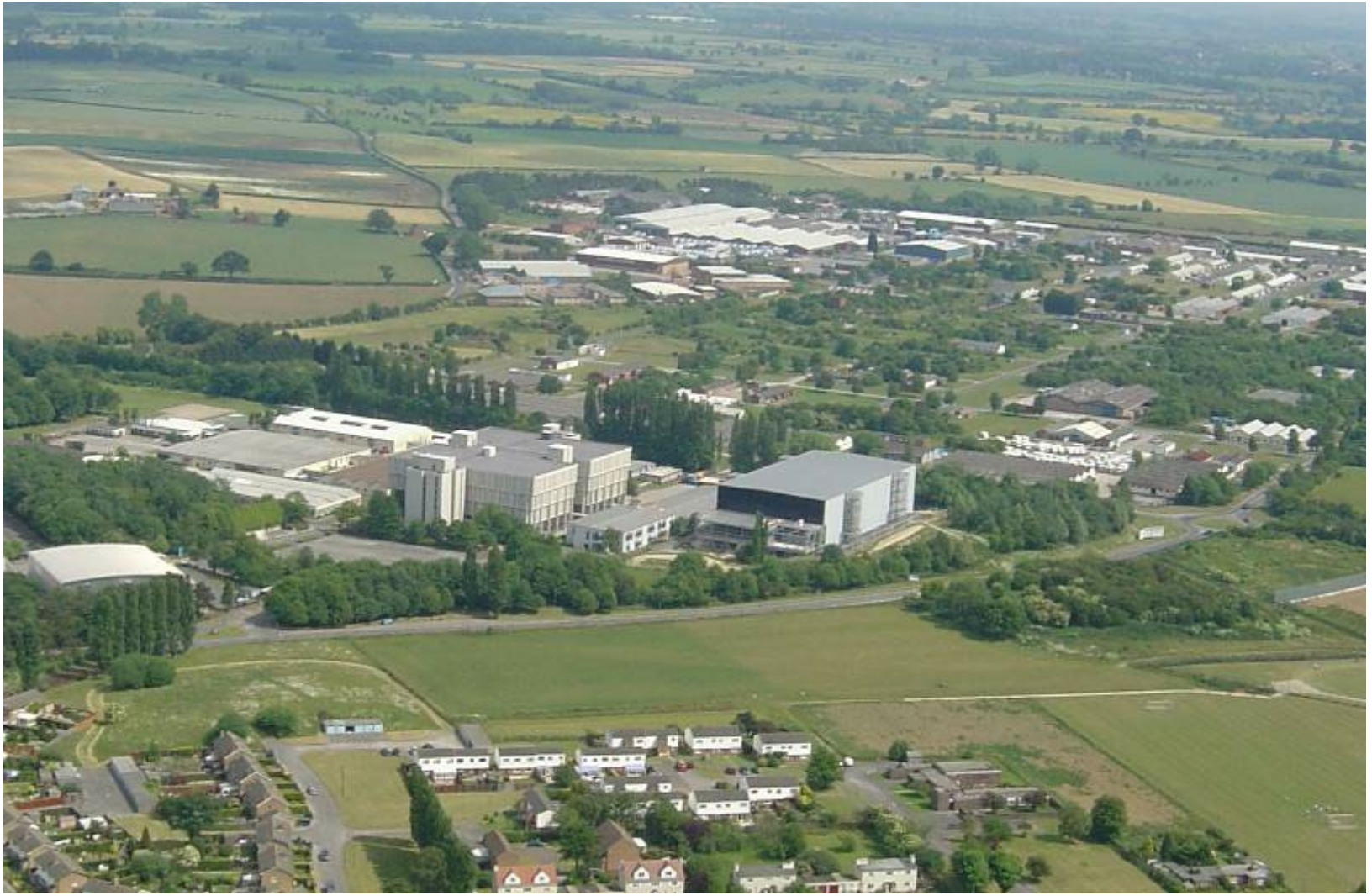
- 162 miles storage ('til 2016)
- High Density, High Bay, fully Automated
- Sprinklers, fire compartments
- High sensitivity smoke detection systems
- Temperature 59°F
- Relative Humidity 52%
- 70 year design life
- Energy efficiency / sustainability
- Minimal environmental impact

# The ASP building



THIS IS A CAD DRAWING - HARD REPRODUCTIONS SHOULD BE CARRIED OUT IN ACCORDANCE WITH DA PROCEEDURES

# ASP aerial view 2007



# ASP construction: interior prior to racking installation



PAROC mineral wool composite panel cladding

4-hour fire rating

Racking 70 feet tall

Crane aisles 2.6 feet wide



# Architects model of racking and crane



# Fully automated retrieval and delivery



Automation test cell  
Spring 2007

- Racking
- Conveyors
- Load handlers
- Crane chassis
- Bespoke totes

## Fire Protection in UK Archives – the received wisdom

### British Standard 5454:2000

- Sprinklers
- Fire compartments
- 4-hour protection
- Smoke extraction

### The reality

- Risk of accidental or partial water discharge
- Freezers to salvage wet books
- For some: no fire suppression at all
- Inefficient building design

## The Problem with Sprinklers (generally, and for ASP)

- Reactive model (thermal trigger): fire is a prerequisite
- Paper meets fire, smoke, and next... water
  
- Sprinkler heads required at all 25 levels of racking
- Fire Compartments incompatible with efficient automation and HD building design
- How maintain sprinkler pipes in racking (up to 70 feet in height)?
- Leaks or accidental discharge
- Totes fill with water, books are immersed, racking..?

# An alternative to sprinklers?



Wagner test facility

Germany 2004

- Oxyacetylene torch
- 15% Oxygen level in the room
- Ordinary office paper

## Low Oxygen (OxyReduct)



OxyReduct used in mainland Europe by the Gas, Oil, IT, and Chemical industries

Used where water would cause more problems

Approved by European fire institutes and insurance bodies

## Benefits of Low Oxygen

- Preventative model
- Nitrogen is an inert gas: no effect on paper-based collections
- Ideal for new build with automation
- Proven effectiveness in preventing fire
- Early detection of even non-visible pyrolysis
- Continuous monitoring throughout storage space
- Assets are protected for min. 72 hours even if OxyReduct system fails catastrophically
- Simple to install and maintain

# ... not for everyone? Issues in legacy buildings





# Groningen University Archive



# Groningen University Archive



## Further investigation & risk assessment



Hugo Boss cloth warehouse  
Germany

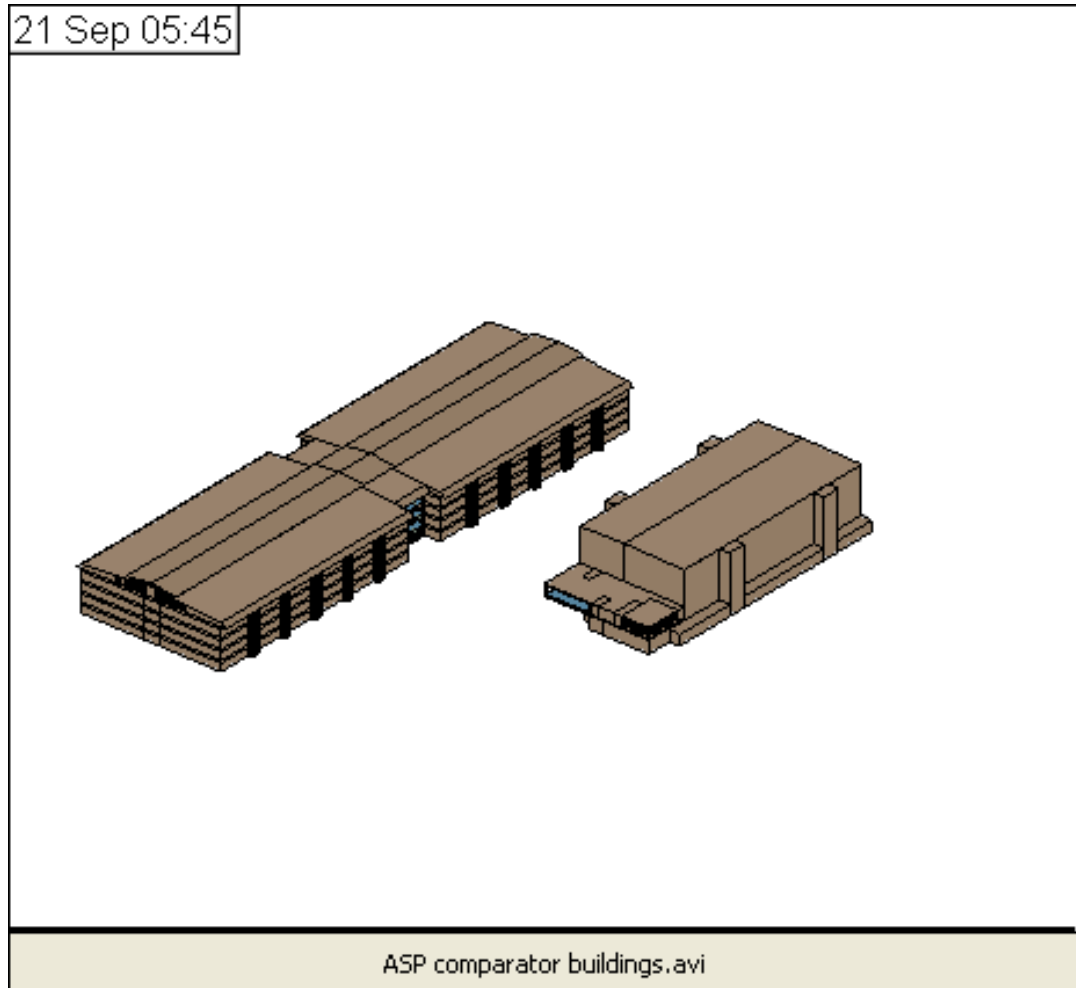
2002: two cloth storage  
warehouses with sprinklers

2004: single cloth storage  
warehouse with OxyReduct

Hugo Boss not viable if cloth  
stocks lost to fire

Building holds next 3-4 years'  
of stock

# Environmental impact



# Annual energy comparison

## SUMMARY OF RESULTS

Elemental Breakdown	Annual Energy Comparison		Annual Carbon Emissions		Annual Carbon Dioxide Emissions	
	ASRS Building (MWh)	Comparator Building (MWh)	ASRS Building (tC)	Comparator Building (tC)	ASRS Building (tCO <sub>2</sub> )	Comparator Building (tCO <sub>2</sub> )
<b>Gas Consumption</b>						
Boilers	50	833	3	44	10	162
<b>Elec Consumption</b>						
Fans	1 364	3 456	154	390	566	1 433
Chillers - Sensible Cooling	679	1 440	77	163	282	597
Chillers - Latent Cooling	36	493	4	56	15	204
Pumps	31	86	4	10	13	36
Lights	0	1 225	0	138	0	508
Cranes	919	0	104	0	381	0
Oxygen Reduction System	575	0	65	0	238	0
<b>Total Energy Consumption</b>	<b>3 654</b>	<b>7 533</b>	<b>411</b>	<b>801</b>	<b>1 505</b>	<b>2 940</b>

# Cost comparison with sprinklers

Suppression method		
	System	Secondary
OxyReduct	<p>\$1.05M</p> <p>70 year cost \$3.3M</p>	<p>Saving on smoke detection system \$40,000</p> <p>Annual maintenance costs \$17,000</p> <p>Annual power consumption \$26,000</p>
Sprinklers	<p>\$1.58M</p> <p>70 year cost \$3.9M</p>	<p><i>Additional building cost due to increased building size \$900,000</i></p> <p>Annual maintenance costs \$20,000</p> <p>Running cost estimate \$500 per annum.</p>

## Implementation at the British Library: specification

- BS 5839 to P1 standard
- 15% Oxygen level throughout storage areas
- Compatible with site wide GENT fire detection/alarm system
- Independent parallel HSSD system
- Nitrogen tanker port
- 3 Nitrogen compressors: 2 online, 1 standby, all 3 in emergency
- Building Air Leakage Index target value: 0.5

# Implementation: building air tightness



Hammersens, Osnabruck

PAROC air test box:

- 4 metres square
- 400mm thickness
- 4-hour fire resistance
- High thermal capacity
- ASP: 11 KM of joints

ALI value of 1 =

1 cubic metre of air leaking through  
1 square metre of building envelope  
in 1 hour



# Implementation: air tightness testing during construction



## Concluding remarks

- Benefits of Low Oxygen
- Do sprinklers have a future in archives?
- Progress on-site
- Air tightness test results
- Experience a Low Oxygen environment ...

## IAMFA Conference 2008

IAMFA 2008 London Conference

15<sup>th</sup> – 17<sup>th</sup> September

Visit to ASP site on September 18<sup>th</sup>

Tour the ASP building and breathe 15% Oxygen

More information:

<http://www.iamfa.org/>