Image/ Please note, Duxford images are copyright of Richard Ash / IWM

Location: Imperial War Museum, Duxford

Construction: Concrete blockwork, insulated timber, Corten cladding

Construction completion: 01/2019

Occupied since: 01/2019

Certification Date: 10/2020

Gross External Area: 1237 m^2

Treated Floor Area: 1365 m^2

Form Factor Ratio: 2.49

Construction cost: £1971/m^2

Heat Source(s): Electric

Primary Energy (PE):
26 kWh/m^2/a

Heating Demand:
2 kWh/m^2/a

Air Changes/Hr:
0.03@50pascals

Heating Load:
3 W/m^2

Primary Energy (PER) Demand:
10 kWh/m^2/a

Primary Energy (PER) Generation:
0 kWh/m^2/a

TEAM CREDITS:

- Client/ Developer: Imperial War Museums
- Architect: Architype
- PH Consultant: Architype
- Contractor: Fabrite
- Certifier: WARM
- Other Consultants: Elemental Solutions/E3, Momentum, Fraser Randall, Avison Young

PROJECT OVERVIEW

The Paper Store provides world class preservation with a pioneering low cost and low carbon approach.

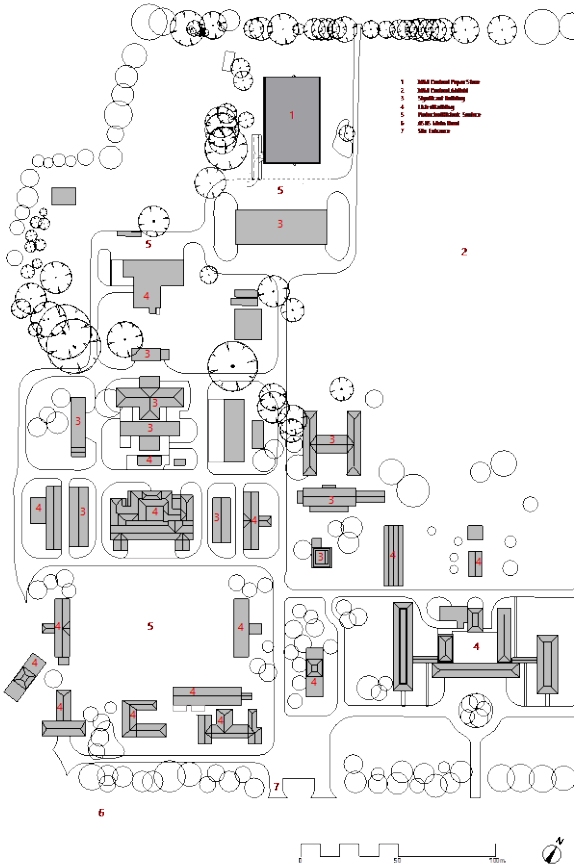
The dramatic archive building protects vital records that show how conflict has shaped the world. The inventive Passivhaus approach uses the archive's connection to the ground to moderate temperatures, naturally. This approach delivers an incredibly stable internal environment for preservation, and drastically reduces operational costs for the museum. Carbon impact is minimal with a simple control strategy and durable materials extending building life for over 100 years. The delicately perforated corten steel façade sensitively responds to the historic site and surrounding mature trees. The archive provides flexible and practical spaces for archivists and is a beautiful tribute to our collective history.

DESIGN PHILOSOPHY & SITE PLAN

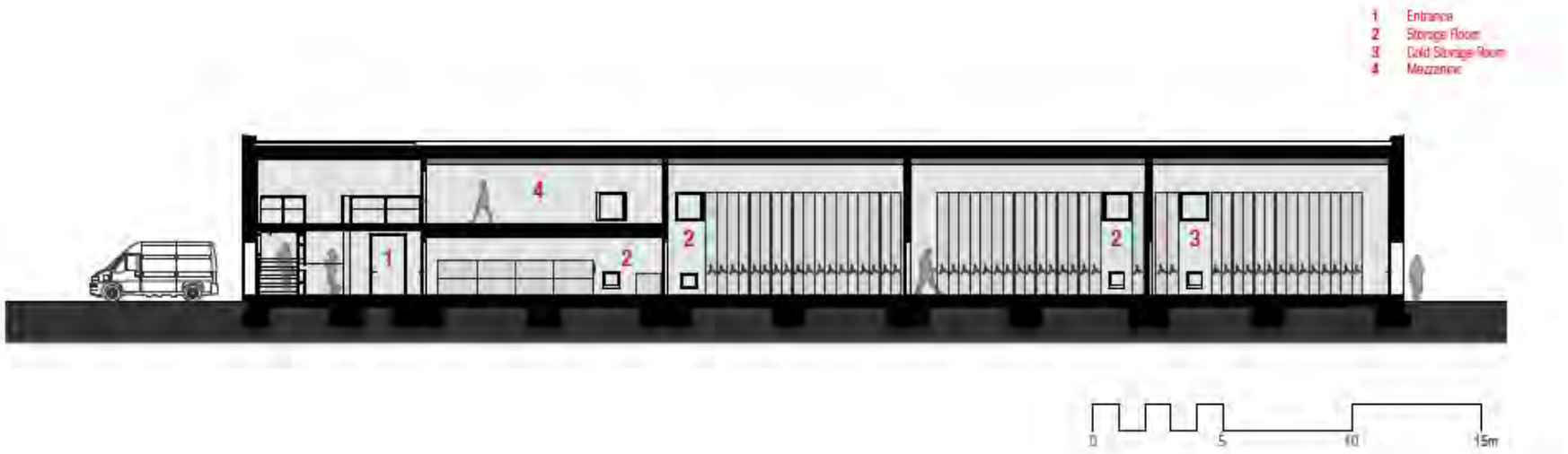
Site Plan

The site is considered to be the best surviving example of a World War fighter base, and therefore is of enormous historic value. The north site, where the Paper Store is located, consists of buildings that were ancillary to the airfield and therefore contains a range of buildings uses and scales such as the mess building, barracks, and cinema. We placed the new store building towards the perimeter of the site, out of view from the most sensitive views from within the site and carefully designed the length of the four sides of the large building to avoid it looking out of scale with the neighbouring buildings. This is in keeping with the pattern of having larger buildings – those often used for storage of equipment and/or vehicles – towards the site's perimeter.

The building is deliberately designed to be a single, simple, rectilinear volume, echoing the pattern of the regular shaped buildings on the site and is orientated to sit within the same rigid grid pattern. Ridge levels for the new building were also kept below the height of the adjacent buildings.

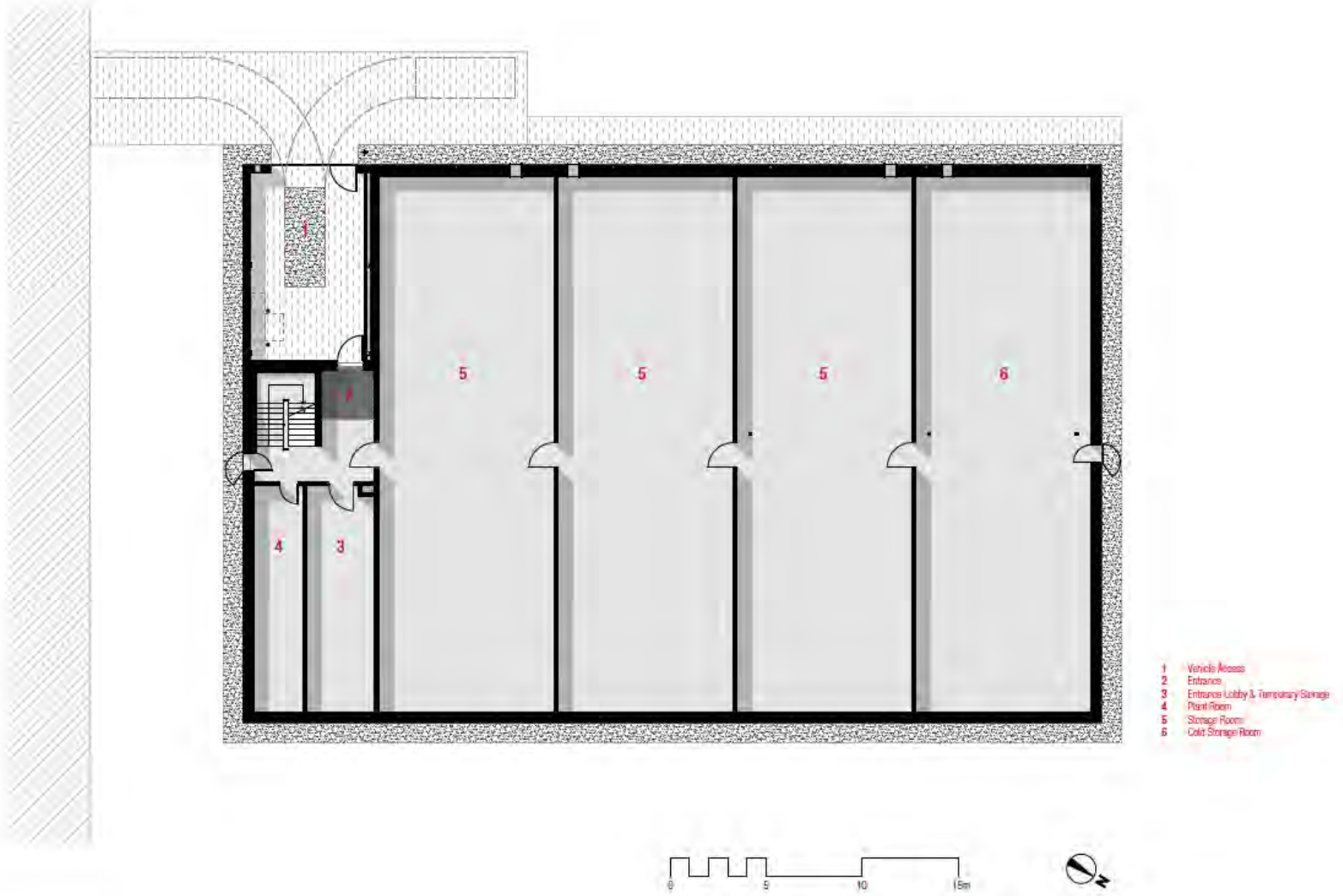


Key sections & elevations



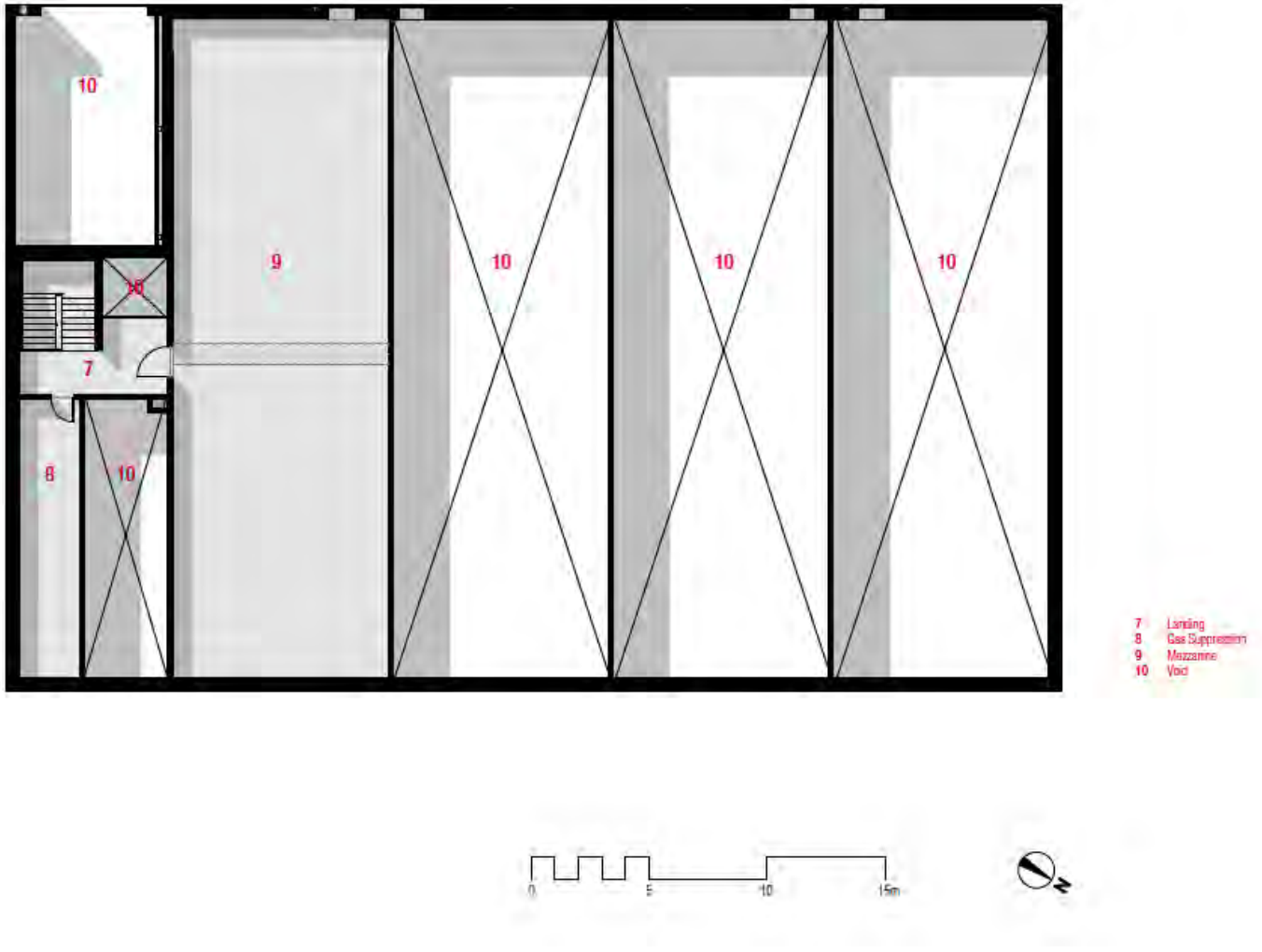
Image/ North East elevation shows The Paper Store in the historic landscape of Duxford, adjacent to WW2 buildings

Plans

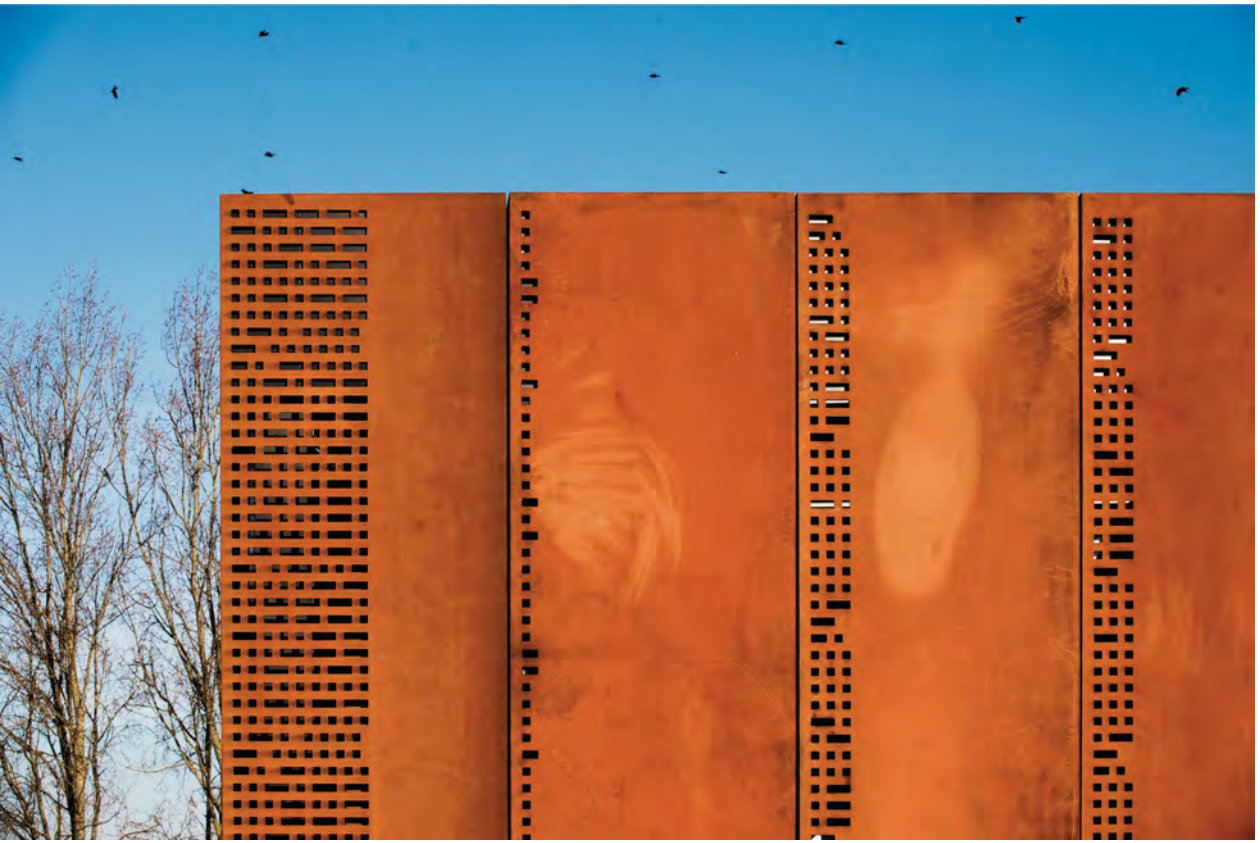


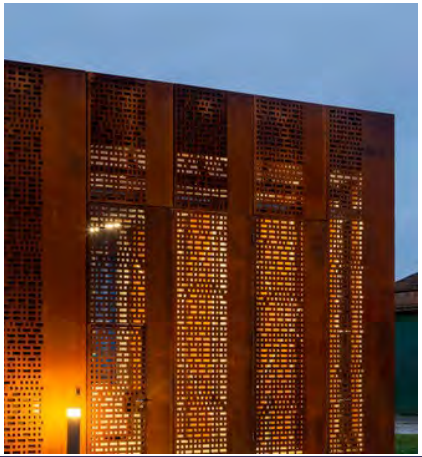
Image/ Ground floor plan

Plans



Image/ First floor plan

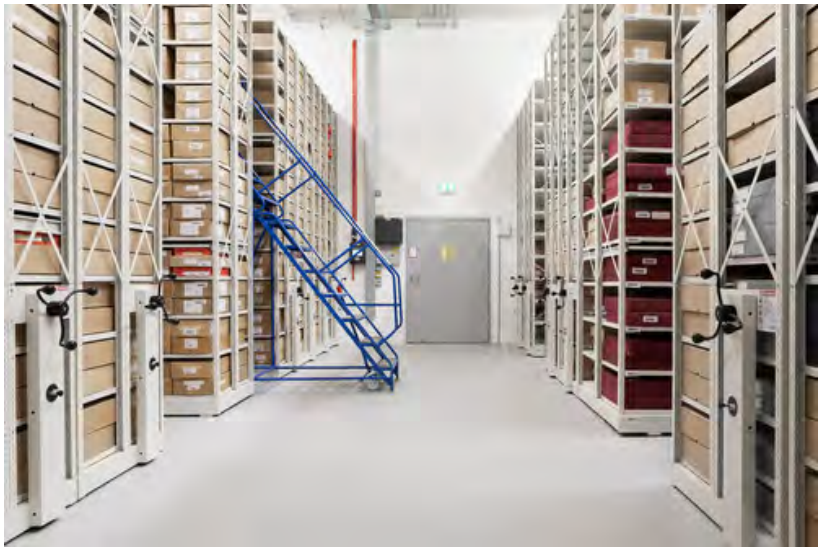




Folding doors allow van access and precious items to be transferred to the store without damage by weather conditions. 100 perforated panels reflect the number of the objects stored from wartime history each year

ARCHITECTURAL DESIGN & AESTHETICS

Image caption



IWM’s priceless collections include items from the Nuremberg Trials. Archivists need easy access to collections but are not based in the building

ARCHITECTURAL DESIGN & AESTHETICS

Summer comfort strategy:

No. Occupants:

Non-residential, but used by around approx. six workers

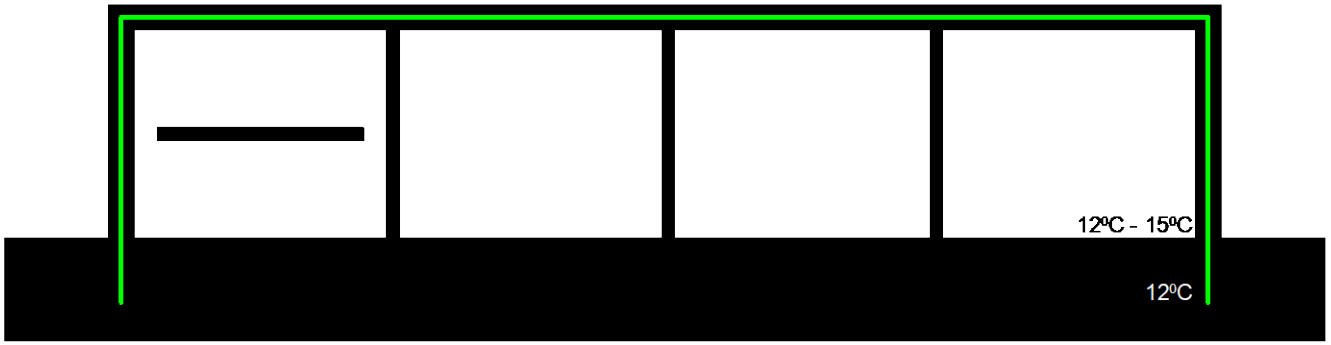
% Overheating/year:

0.0

The building was originally modelled in PHPP with the assumption that it would be heated to maintain a minimum winter temperature of 13 °C. As the design progressed the brief changed to require 'as low a temperature as feasible without the use of active cooling'. For this approach the PHPP was modified to model a free-running unheated building with ground coupling using the summer sheet to predict monthly temperatures.

The low winter temperatures avoid the need for humidification. There is no dehumidification of the air in the building, instead supply air dehumidification is used to pressurise the building with fresh air of a fixed dew point. The minimum winter temperature of about 11 °C allows us to maintain the RH comfortably below 60% using chilled water rather than the more usual desiccant dehumidifiers.

The design does not rely on window opening as it's an archive for sensitive material.



The open loop approach avoids the need for RH sensors for control. Indeed no building management system is required as the only control is the chilled water temperature. The plant comprises a package water chiller with integral controls, a cooling coil and a Zehnder Q350 domestic MVHR unit used to pre-cool the incoming air. This reduces chiller energy use as it basically only meets the dehumidification load, with minimal reduction of supply air temperature. Heat from the chiller is rejected to atmosphere as we do not want to add heat to the store during

% Overheating/year:

There are no elements that open at night for night ventilation.

Glazing represent 0% of TFA.

SUMMER COMFORT & VENTILATION

Monitored data graphs / charts / POE

“Architype were remarkable because of their proactive, flexible approach to developing a low-cost, high quality solution to our brief. Their enthusiasm to partner with our team has resulted in innovative and sustainable solutions that respect our historic site, and an air-tight building that performs over 150 times better than regulations require. The process of working together, and with their engineering partner Elemental Solutions, was a pleasure and our combined love is evident throughout. We now have a beautiful, world-class store that performs far better than the previous buildings, has reduced our carbon impact and running costs to a minimum, and has the flexibility to easily expand in the future. The care that has gone into drastically simplifying services means it is very easy to operate and access is vastly improved, making our staff’s working lives much easier.”

Gael Dundas / Assistant Director IWM Collections Management

Monitored data graphs/ charts

Air tightness: 0.03 air changes per hour (target 0.6 ACH)

Useful cooling demand:

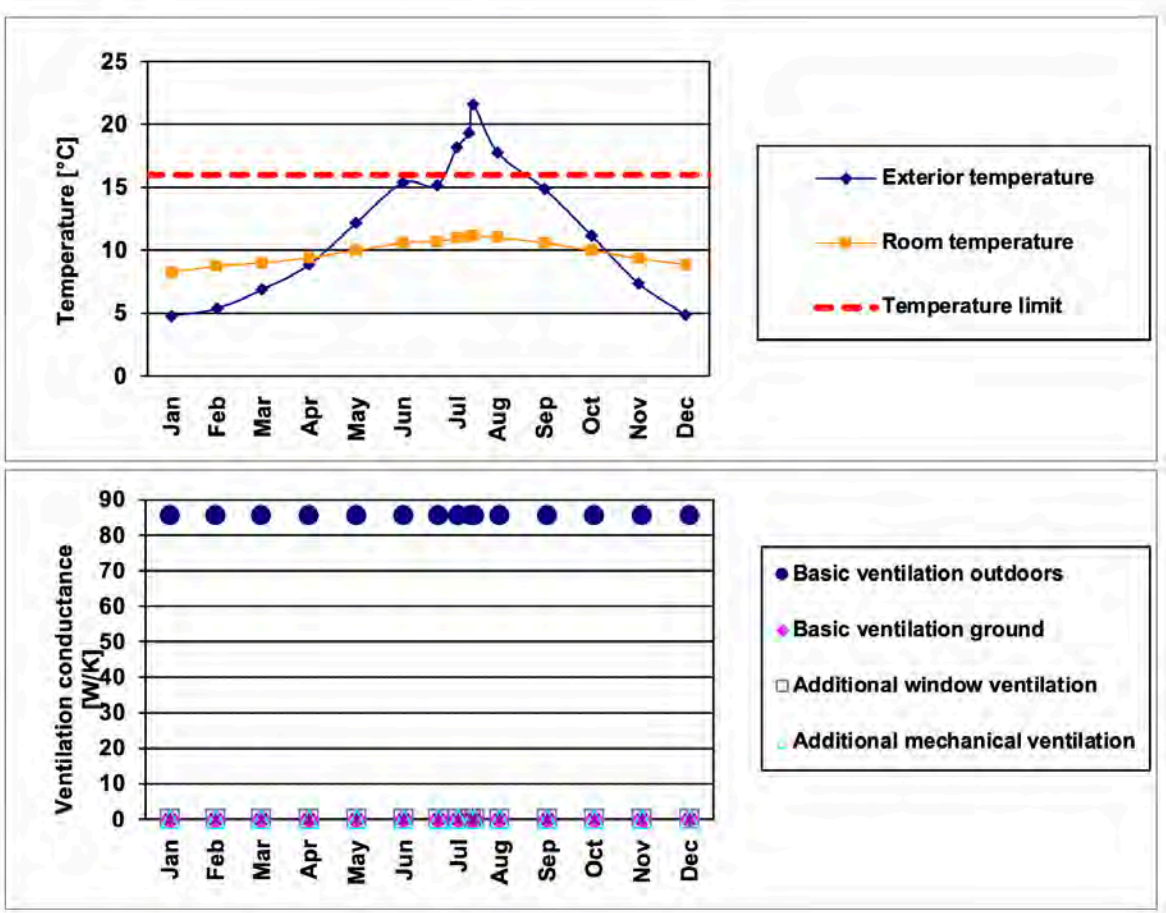
0.0kWh/(m2a)

Dehumidification demand: 2.7kWh/(m2a)

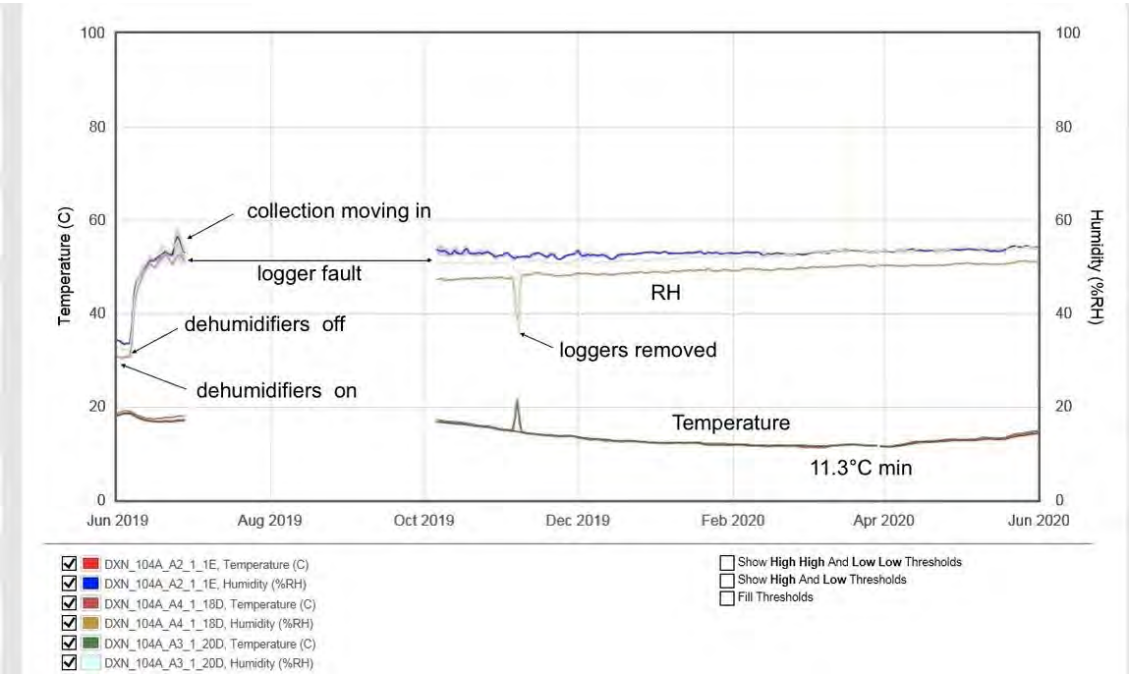
Frequency of exceeded humidity: 0.0%

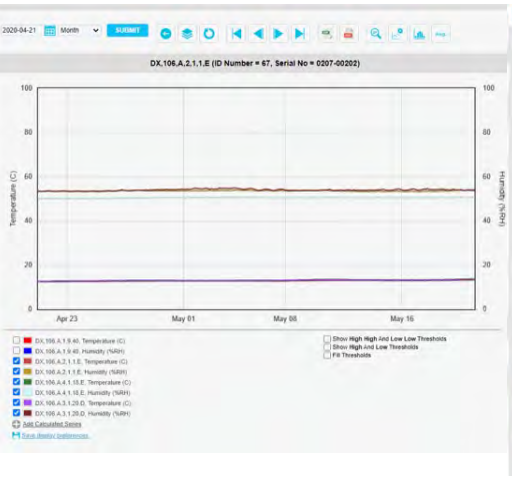
Frequency of overheating:

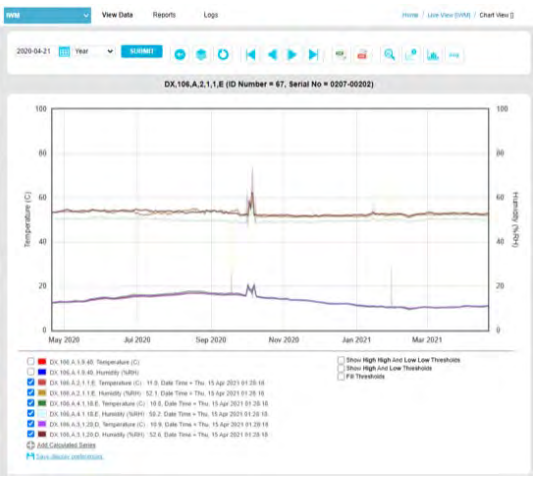
0.0%

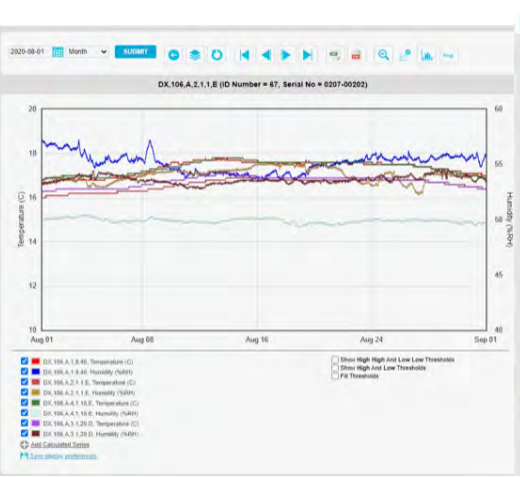


Monitored data graphs Temperature & Humidity









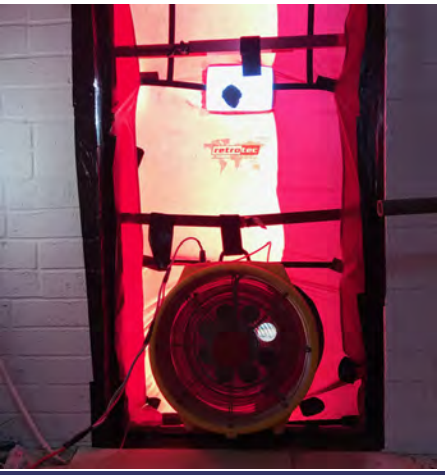
PERFORMANCE & USER FEEDBACK

Key Construction Innovations

The design was a specialized fabric system, that innovated passive cooling under the rigorous and highly-controlled standards that are required for archives, building on Architype's learnings from the first Passivhaus Herefordshire Archive and Record Centre. The controls are deliberately easy to use, with a minimum amount of plant to maintain, and a central air duct simplifies services, and providing a positively pressurised environment for staff. Fire defence was a priority, and the building uses an innovative fire suppression system to avoid compromising the thermal envelope.

Construction achieved a world-leading air tightness recording, achieved with a liquid-applied membrane.

CONSTRUCTION APPROACH



Interiors including controls and fire suppression

IMAGES

- What was special about this building? (Materials, tight budget, challenging site, design evolution, deliberately standard, self-build, social impact etc).

- What would you do differently?

We would use a bespoke, smaller chiller unit as the demand is lower than predicted.

- The project is a pioneering approach to storage that has created a beautiful, innovative and beneficial new building in an historic site. As well as a world-class performing, highly practical building, the low-cost solution is beautiful and enhances the Duxford estate. Nestling beautifully among the mature trees and historic landscape, the simple rectilinear form and rich patina of the corten steel responds to the form and brickwork of neighbouring buildings, supporting Historic England's goals of distinct chapters for new buildings on historic sites.
- The building achieves world-leading air tightness, a perfect internal environment and an outstanding reduction in operational carbon - at around five percent of comparable storage systems – and was delivered on a budget 30 percent lower than the recommended construction costs for archiving. At a time when cultural organisations are seeing their budgets squeezed tighter than ever before, this rethinks preservation for one of the most important collections in the country
- Each of the steel panels represent a year of the century of archival material held within. As you walk around, highly-perforated panels mark periods of great global conflict, others of relative peace

IMAGES