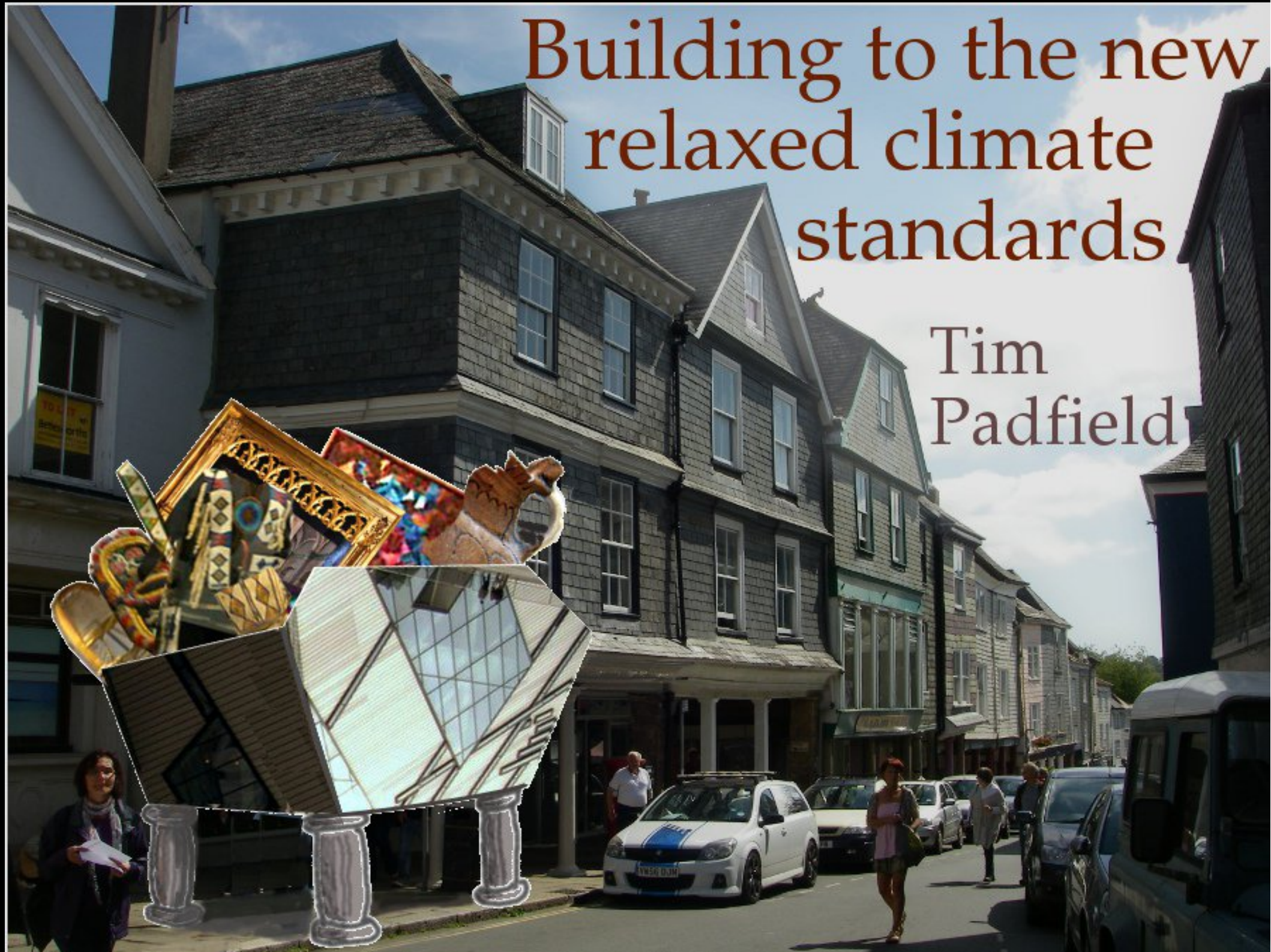
Building to the new relaxed climate standards

Tim Padfield



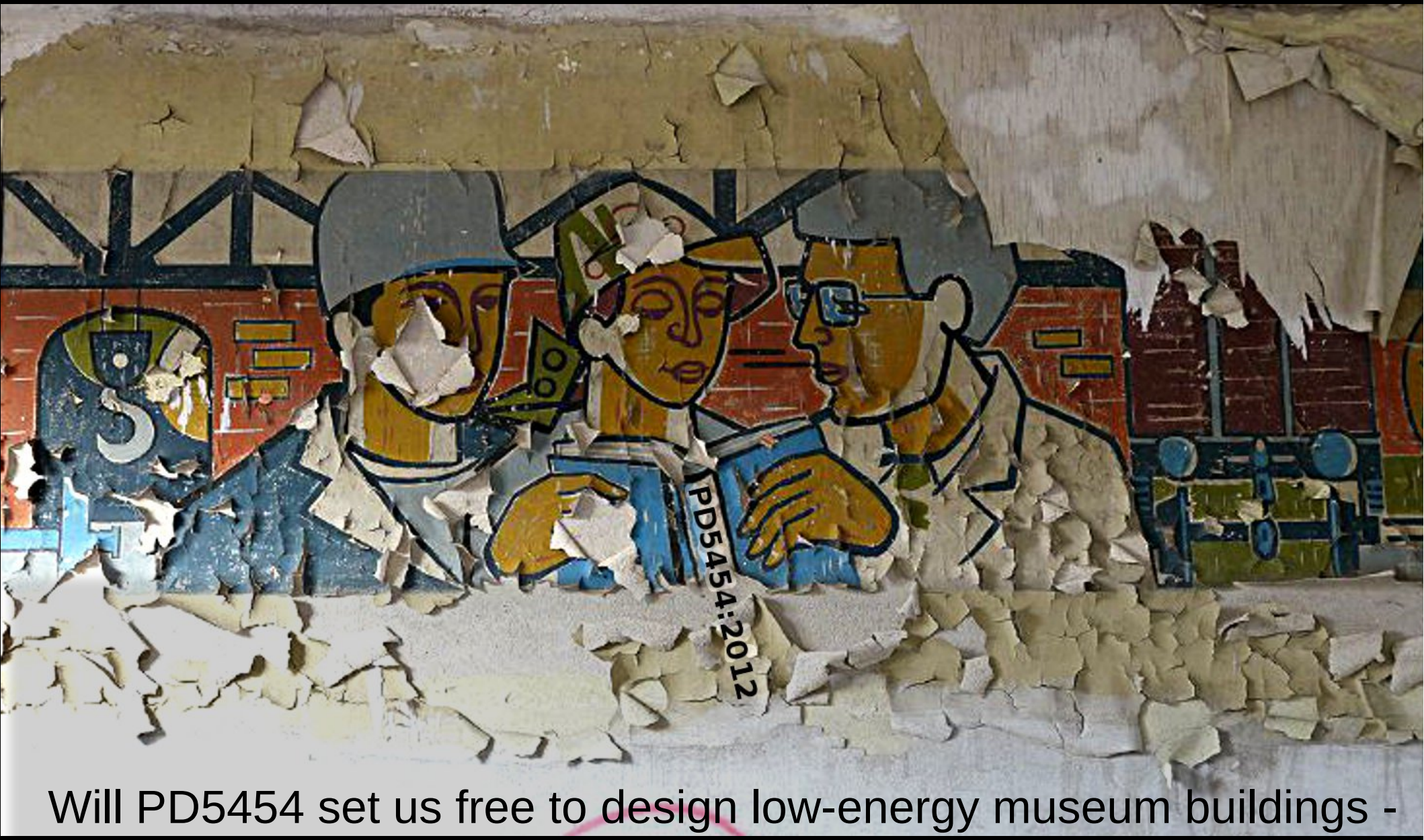
In the twentieth century, abundant energy and air conditioning technology let architects free to fantasise.

Photo: Helen Coxon

But the combination of the Ontario climate and the museum design was too extreme, so individual showcases are air conditioned with piped air

Photo: Helen Coxon

In the gentler climate of the Isle of Wight, English Heritage anticipated the relaxation of museum standards with a simple awning over Queen Victoria's bathing machine

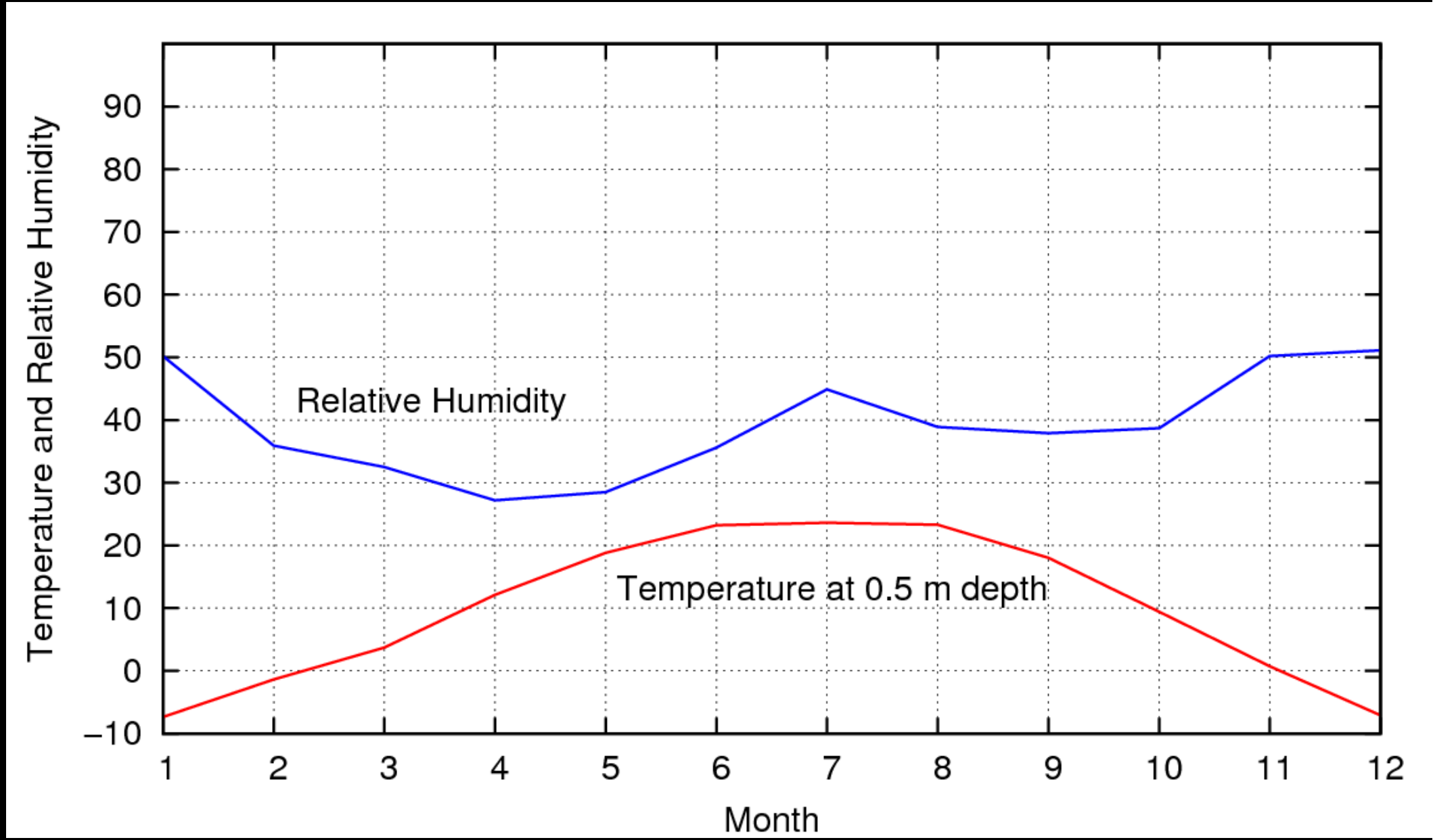


Will PD5454 set us free to design low-energy museum buildings -

or is it a disastrous concession to the energy pessimists,
or is it not quite as generous as it seems?

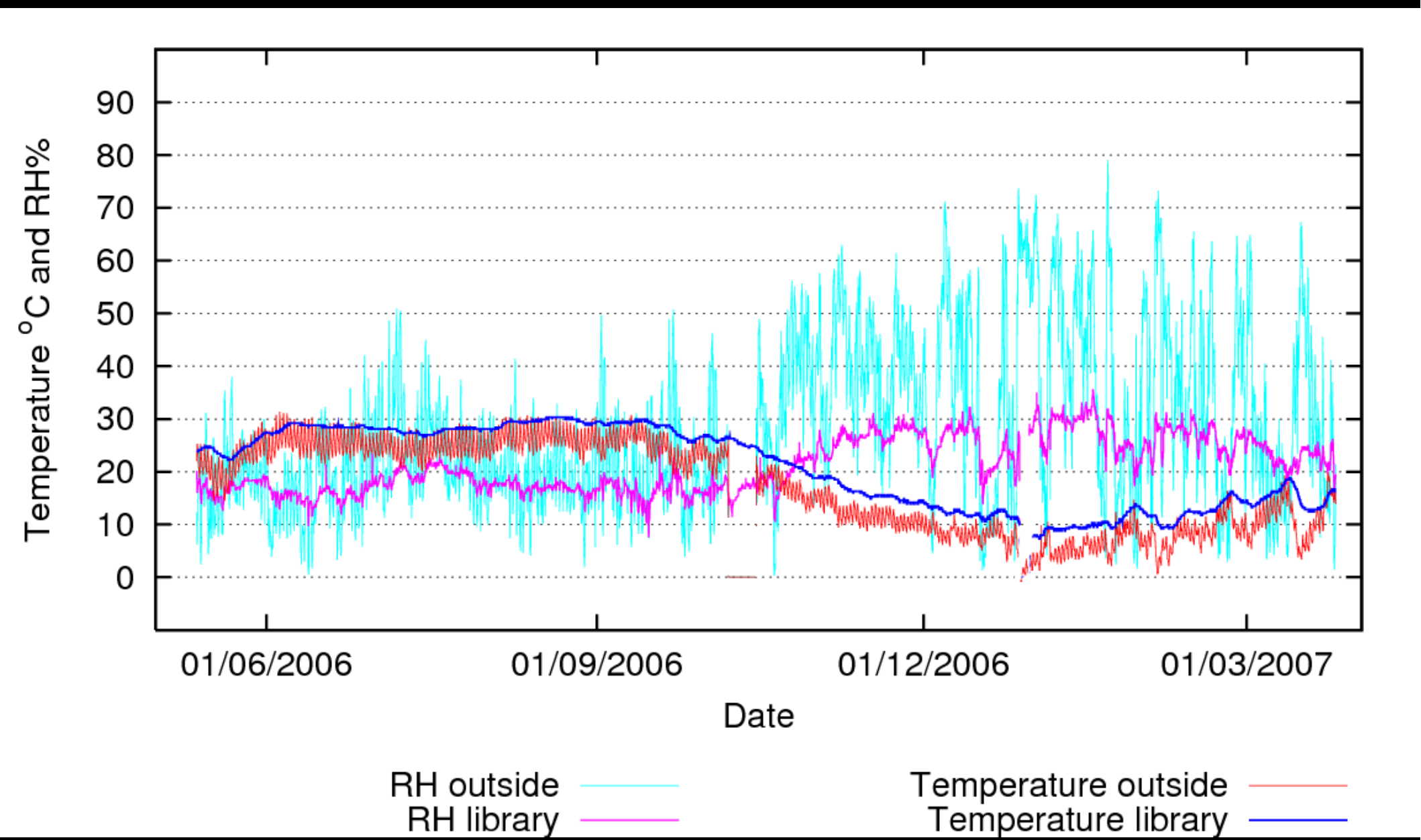
So what is the scientific evidence for the need for strict standards with no permitted variation over the year?

An archive without a roof: In 1901, Swedish explorer Sven Hedin discovered paper from the third century, perfectly preserved under half a metre of blown sand in a ruined building near Lop Nur in the Taklimakan desert of Eastern Turkestan



Climate at 0.5 m depth, Dunhuang, China

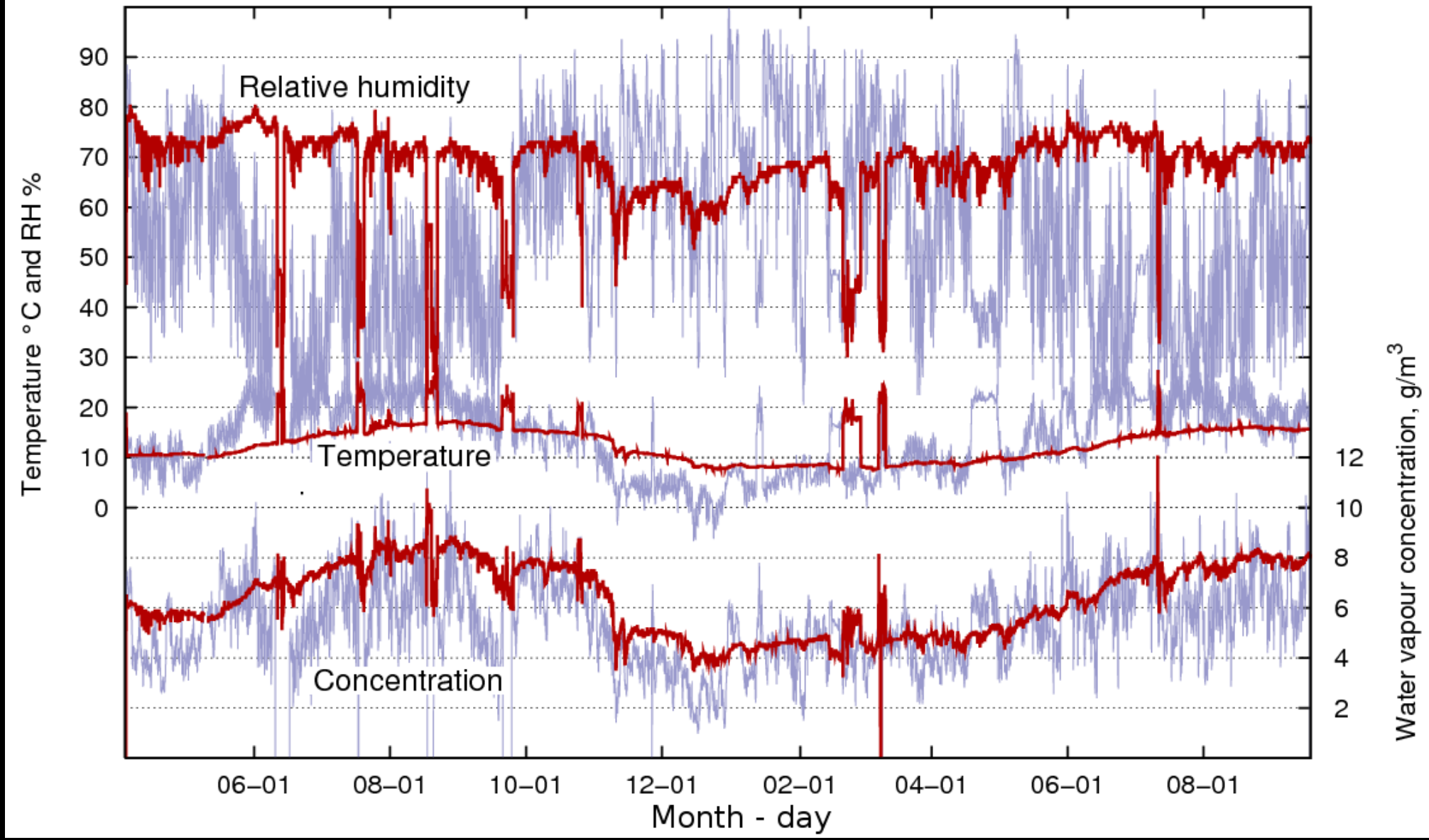
St. Catherine's Monastery, Sinai, Egypt,
home to a library founded in the 6th century



The climate in the library of St. Catherine's Monastery, Sinai.

No heating, low RH, high summer temperature

The Alcazar of Segovia, Spain. It contains the military archive



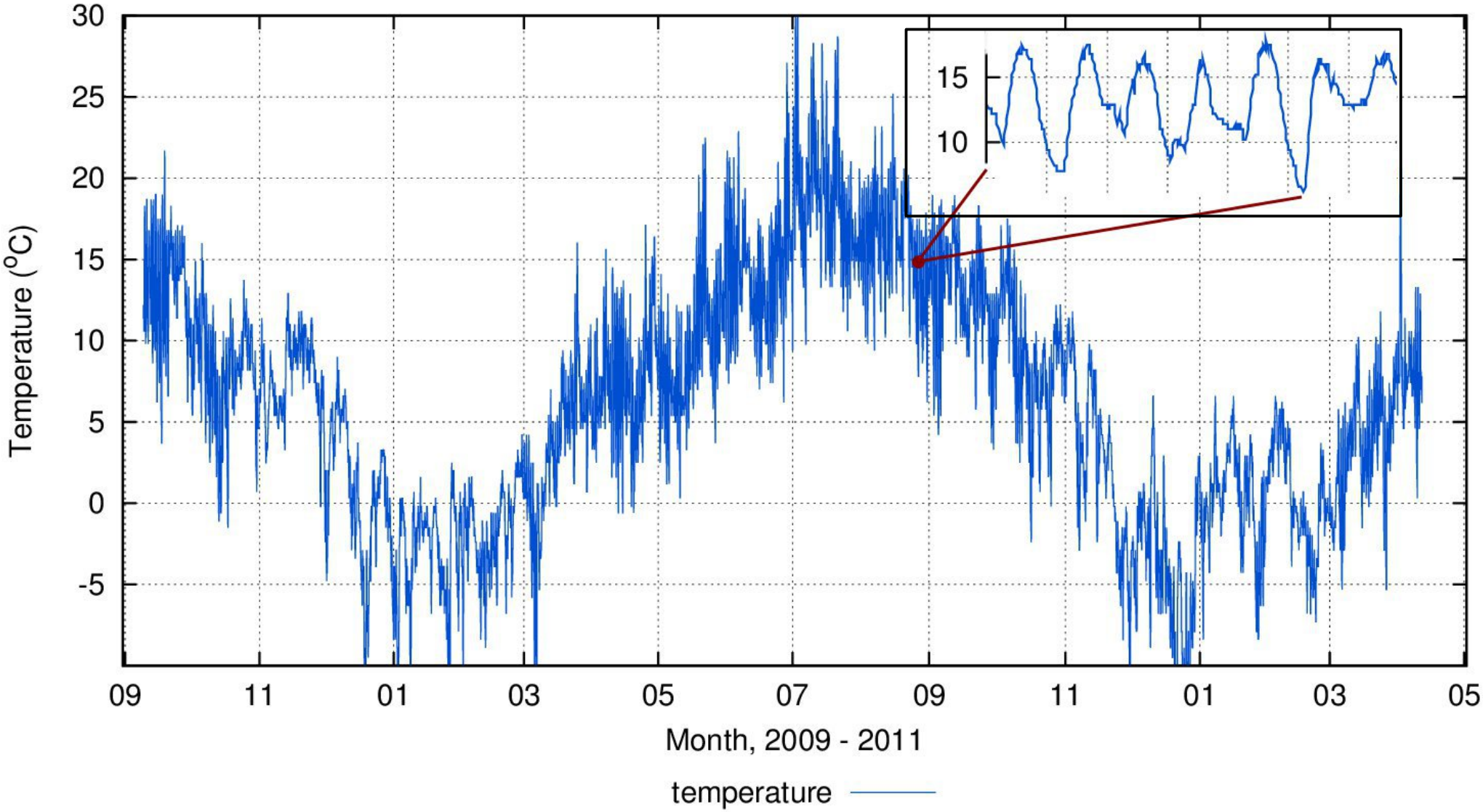
Alcazar archive climate over a year and a half

Naturally buffered by massive construction and paper bundles. No heating – RH perilously high but no mould growth observed.

Source	Media	Temper-ature	Maximum Temp. Gradient	Relative Humidity (RH)	Maximum RH Gradient
ISO TC 171/SC Jan. 2002	CD-R CD-ROM +5	+5°C to 20°C (41°F to 68°F)	4°C /hr (7°F /hr)	30% to 50%	10% /hr
IT9.25 and ISO 18925 February, 2002	CDs DVDs -10	-10°C to 23°C (14°F to 73°F)		20% to 50%	Cycling no greater than: ±10%
NARA, FAQ About Optical Media, April, 2001	CDs DVDs +20	68°F (20°C)	+/- 1°F /day (+/- 0.6°C /day)	40%	5% /day
National Archives of Australia, April, 1999	CDs +18	18°C to 20°C (64°F to 68°F)		45% to 50%	10% /24 hrs
Library Technical Report Nov.-Dec. 1997	CDs -10	-10°C to 50°C (16°F to 122°F)		10% to 90%	
DVD Demystified, Second Edition, Jim Taylor, 2001	DVD-R DVD-ROM -20	-20°C to 50°C (-4°F to 122°F)	15°C /hr (27°F /hr)	5% to 90%	10% /hr
	DVD-RAM -10	-10°C to 50°C (16°F to 122°F)	10°C /hr (18°F /hr)	3% to 85%	10% /hr
	DVD+RW -10	-10°C to 55°C (14°F to 131°F)	15°C /hr (27°F /hr)	3% to 90%	10% /hr
National Library of Canada, 1996	CDs +15	15°C to 20°C (59°F to 68°F)	2°C /24 hrs (9°F /24 hrs)	25% to 45%	5% /24 hrs
Media Sciences, Inc. Jerome L. Hartke	CD-R +10	10°C to 15°C (50°F to 59°F)		20% to 50%	

What about the susceptibility of modern archival materials?

So since there seems to be no concensus among the materials science experts, let us look at museum storage from an entirely different viewpoint:
What sort of building will provide a moderate, but not necessarily constant climate?

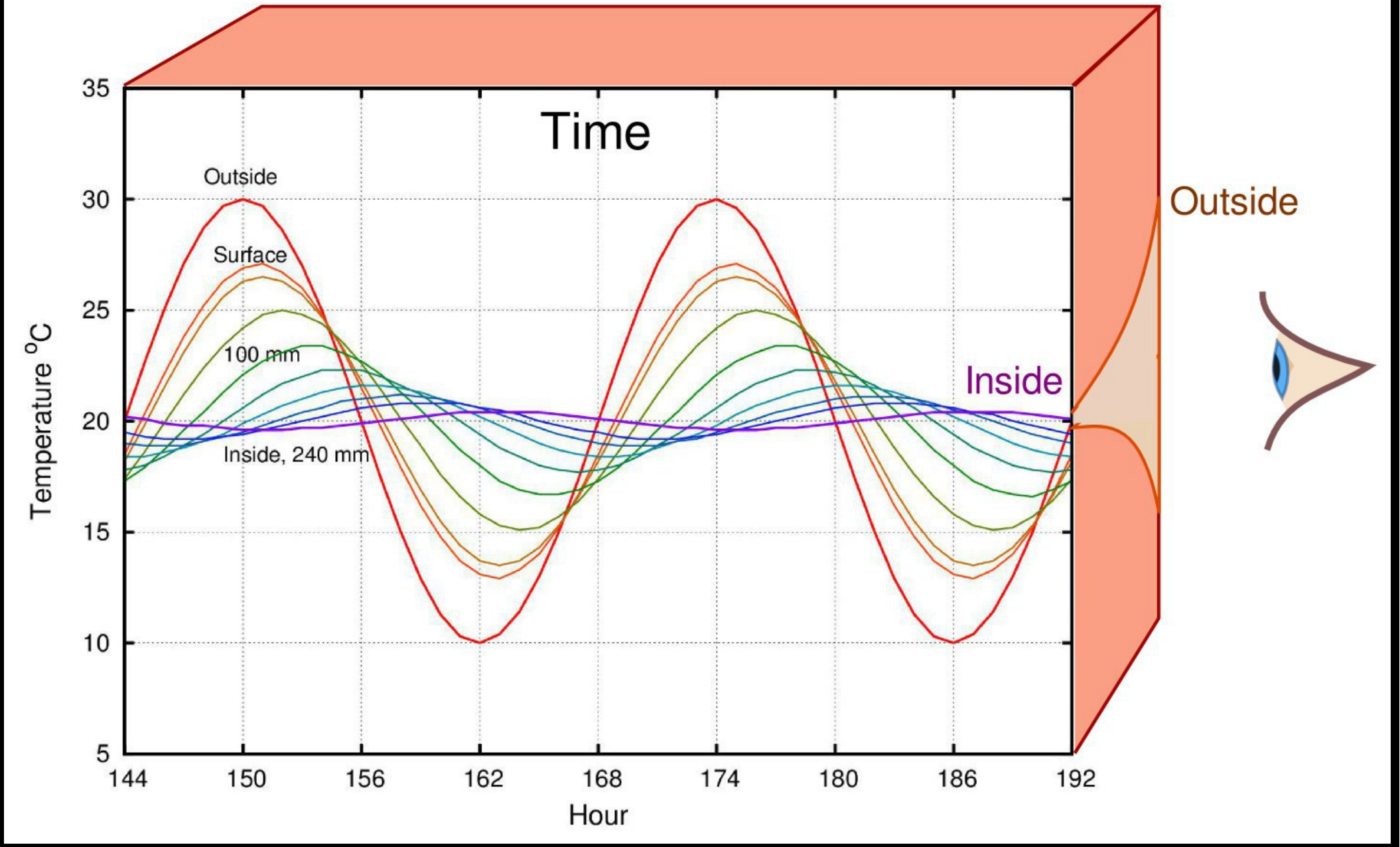


The temperature in Ribe, Denmark
The daily cycles are expanded in the insert

6.3.1 Thermal stability
The construction should be of sufficient density and have air infiltration rates low enough for the temperature and RH to remain stable and within the recommended ranges given in **4.2** for a minimum of 24 hours in the event of exceptional weather conditions or the failure of environmental control equipment.

COMMENTARY ON **6.3.1**
High thermal inertia is recommended irrespective of whether natural means or air- conditioning is used in the construction to achieve environmental stability.

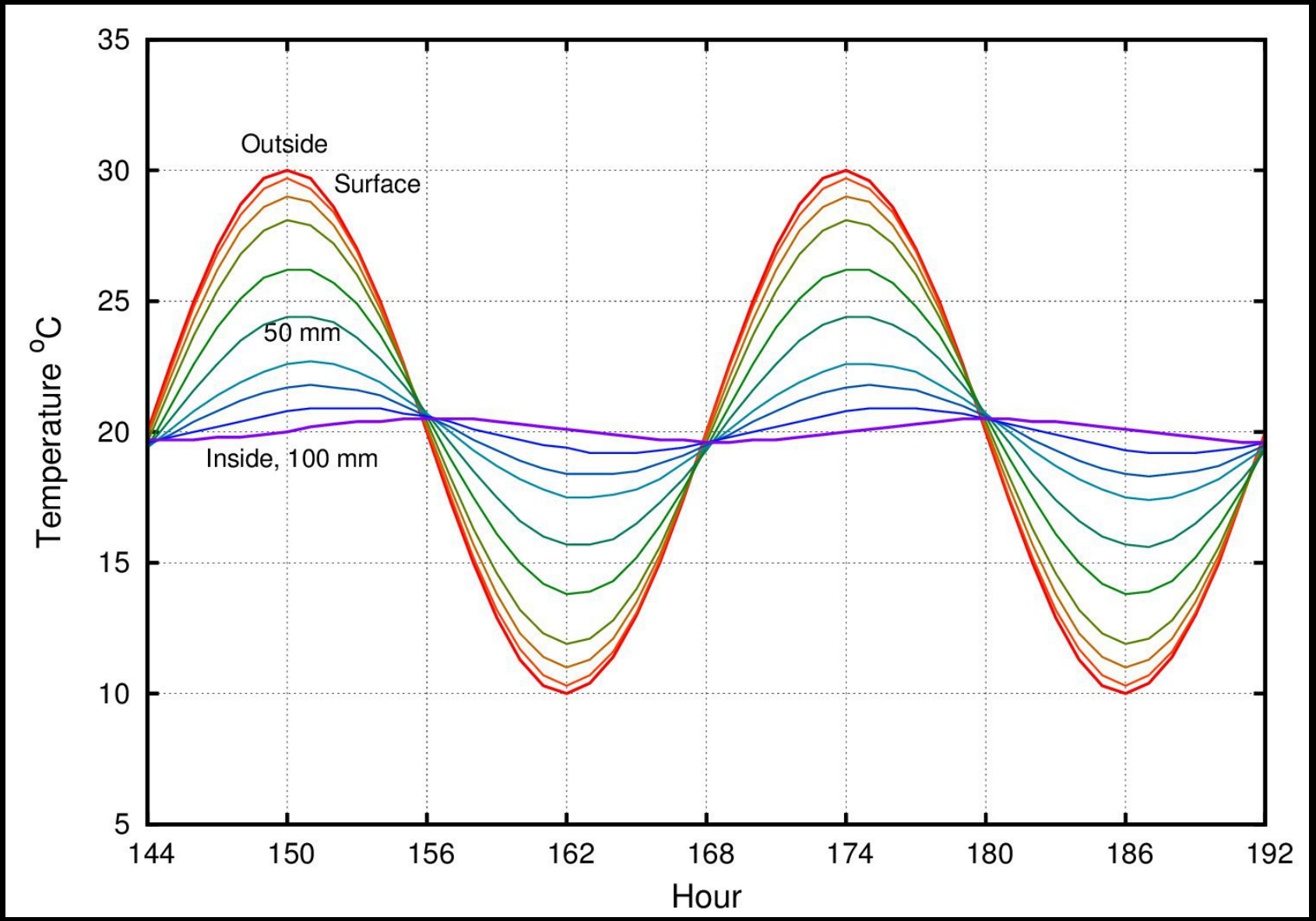
From PD5454:2012



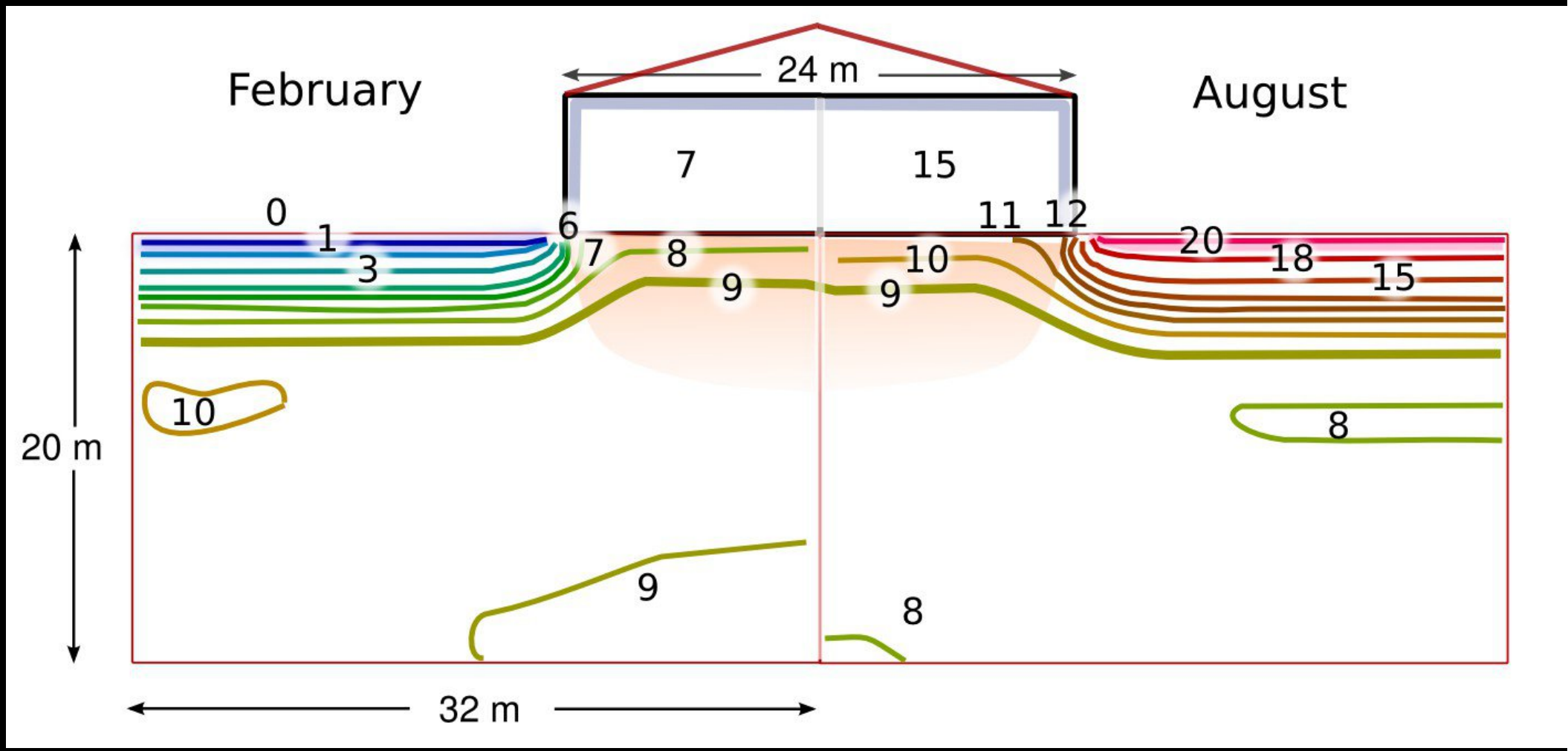
How the daily cycle of temperature penetrates a 240 mm thick solid brick wall

Wall sections of the Cologne city archive

Photo: Der Spiegel

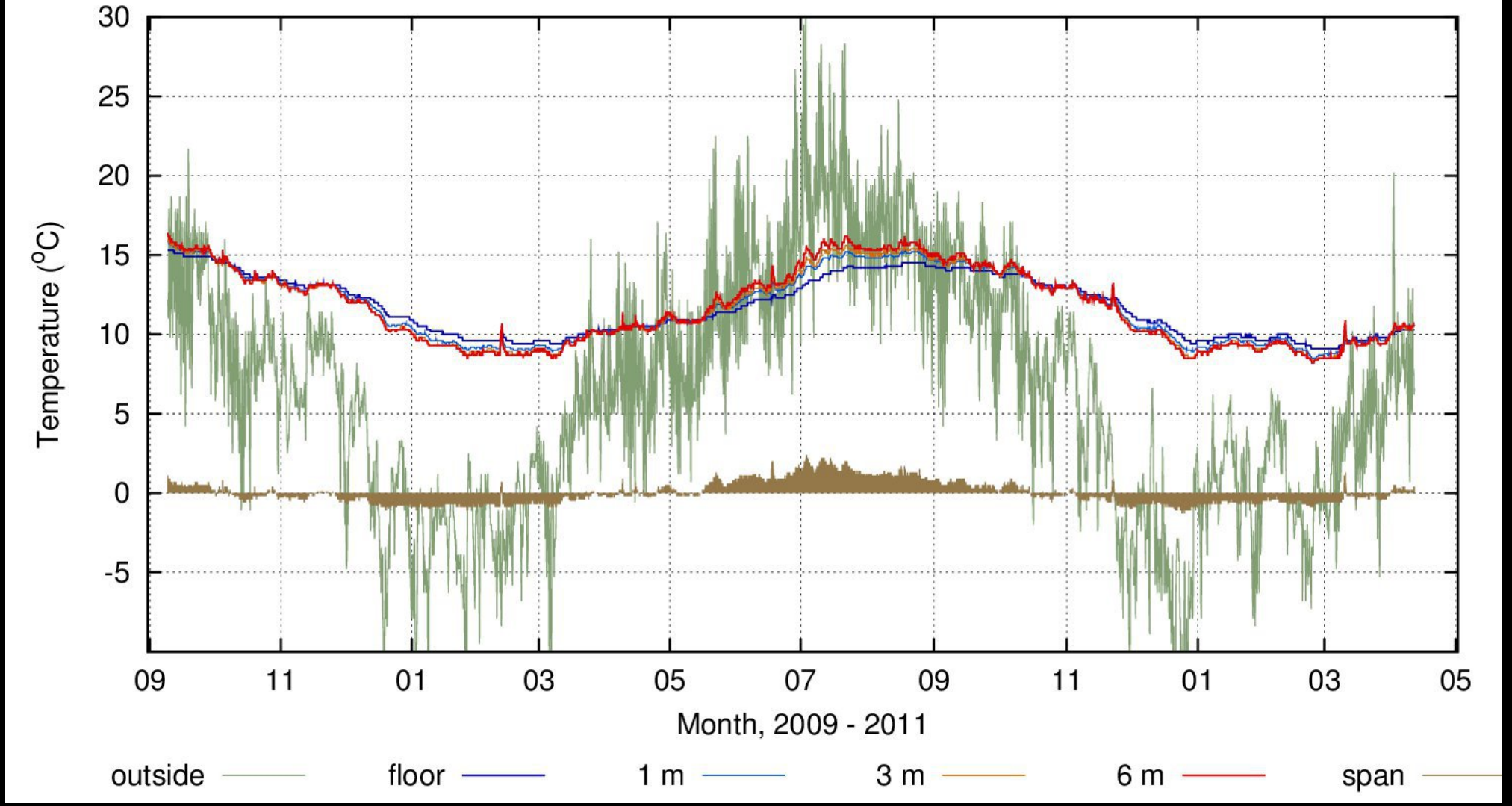


The evolution of temperature within a 100 mm foam wall



Simulation of the underground temperature contours under a museum store, showing how the ground acts as a huge thermal buffer for the building above

Simulation by Benny Bøhm

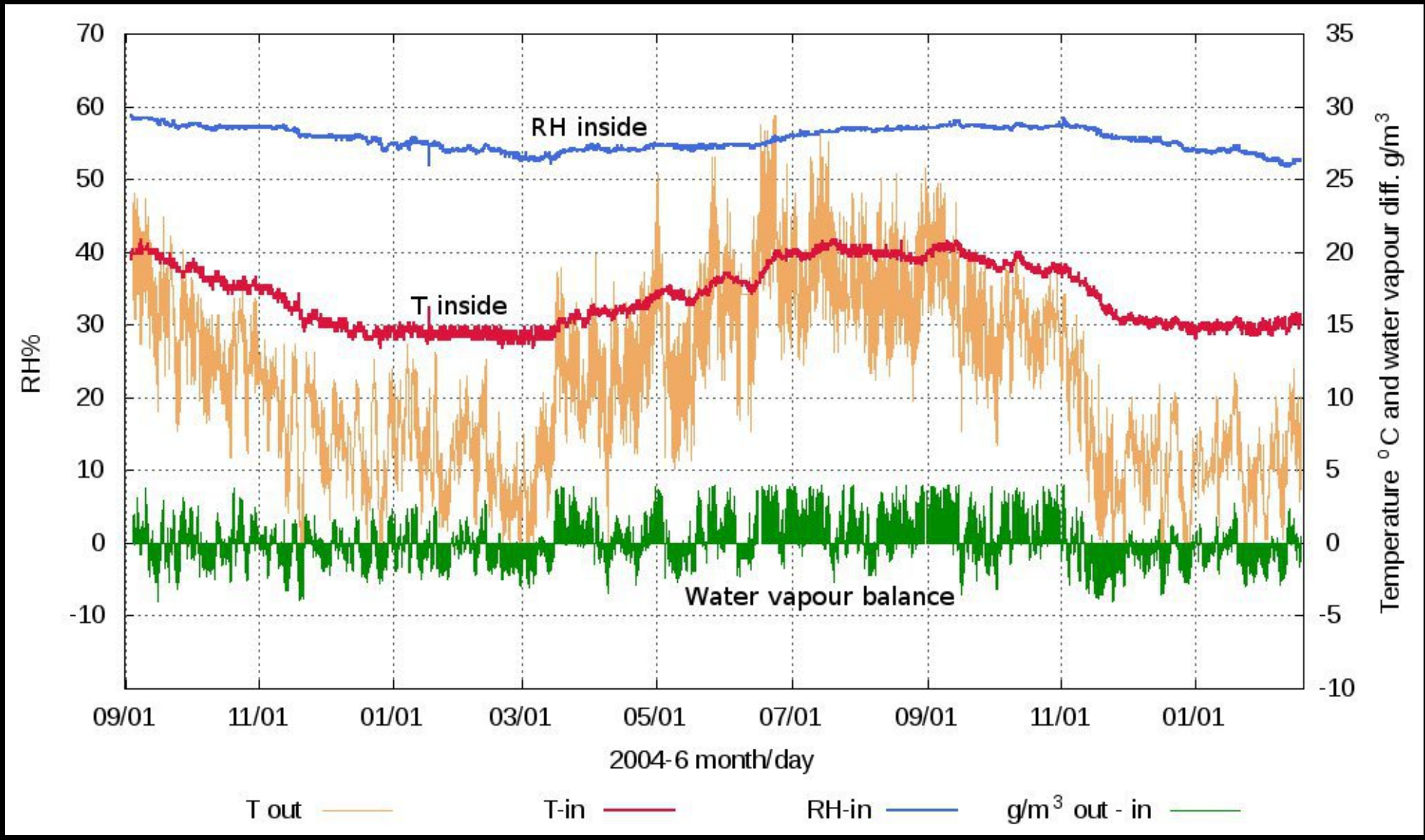


The annual temperature cycle at various heights within the museum store in Ribe.
The annual cycle span is reduced to 8 K.
There is very little temperature stratification

The following ranges of RH and temperature are recommended as a means of preventing even sensitive archival materials referred to within **4.2.2** from being compromised when stored alongside less critically sensitive archival material:

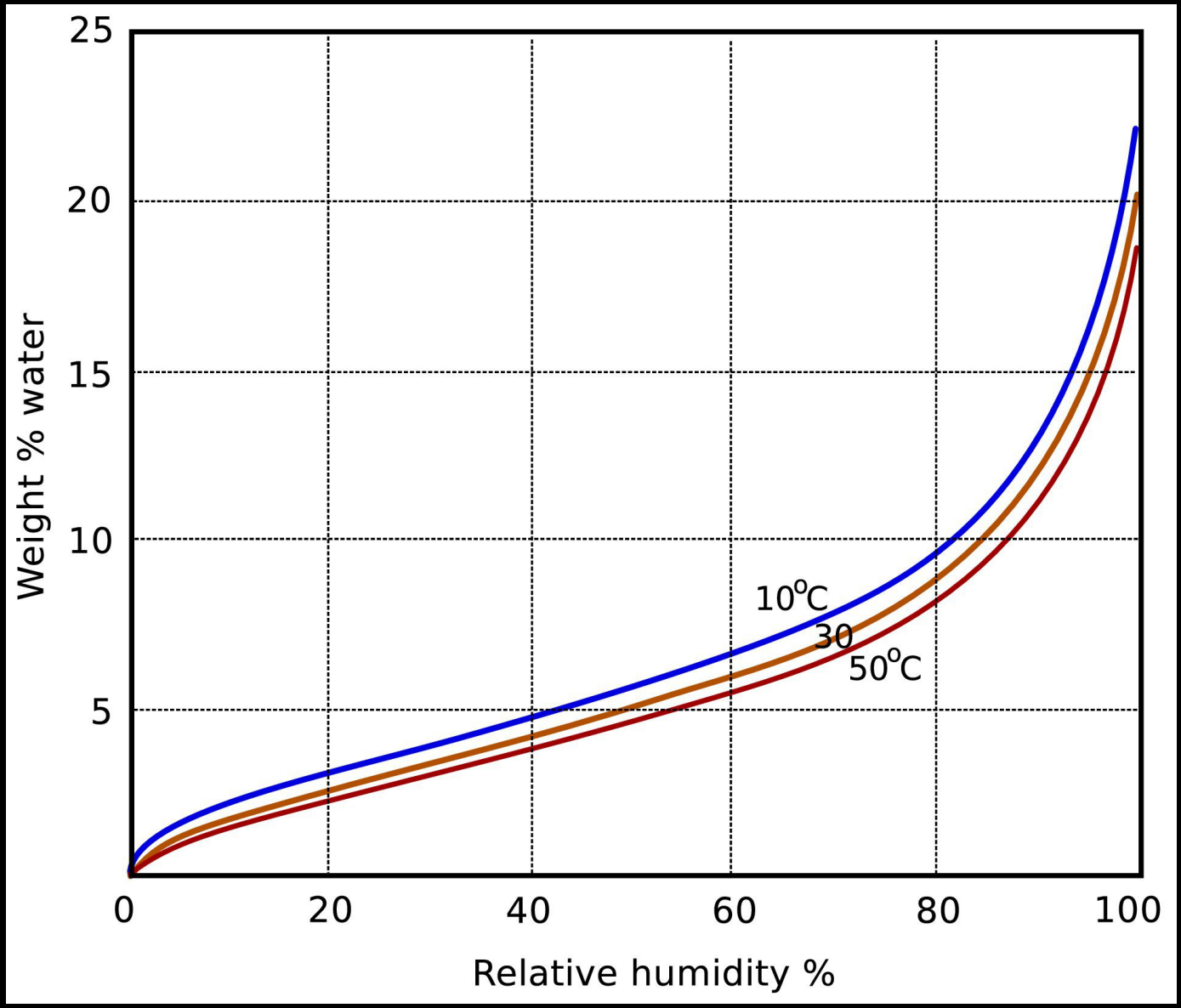
13 °C to 20 °C;
35 %RH to 60 %RH.

from PD5454:2012

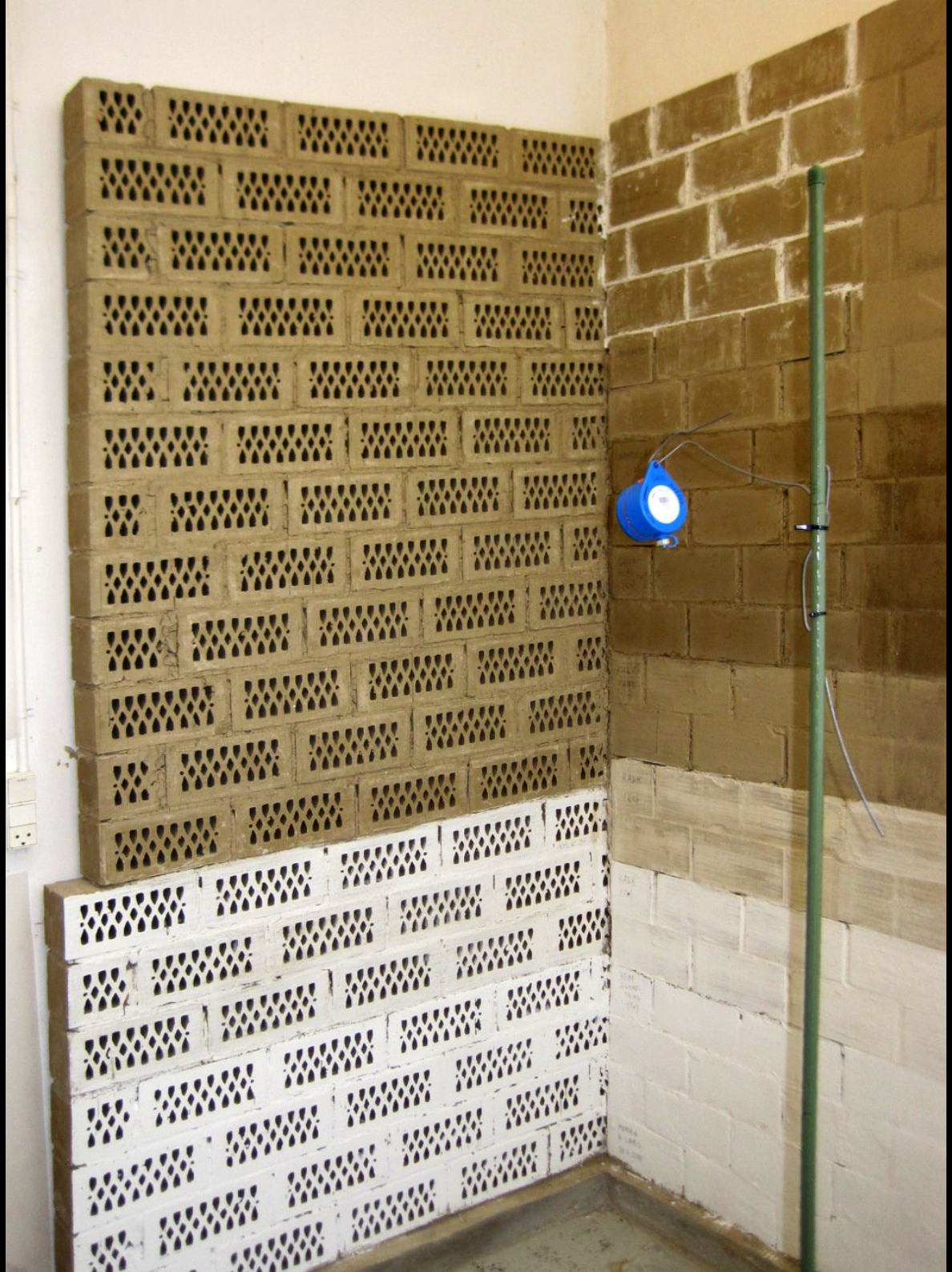


The climate within the Suffolk Record Office, Ipswich UK.

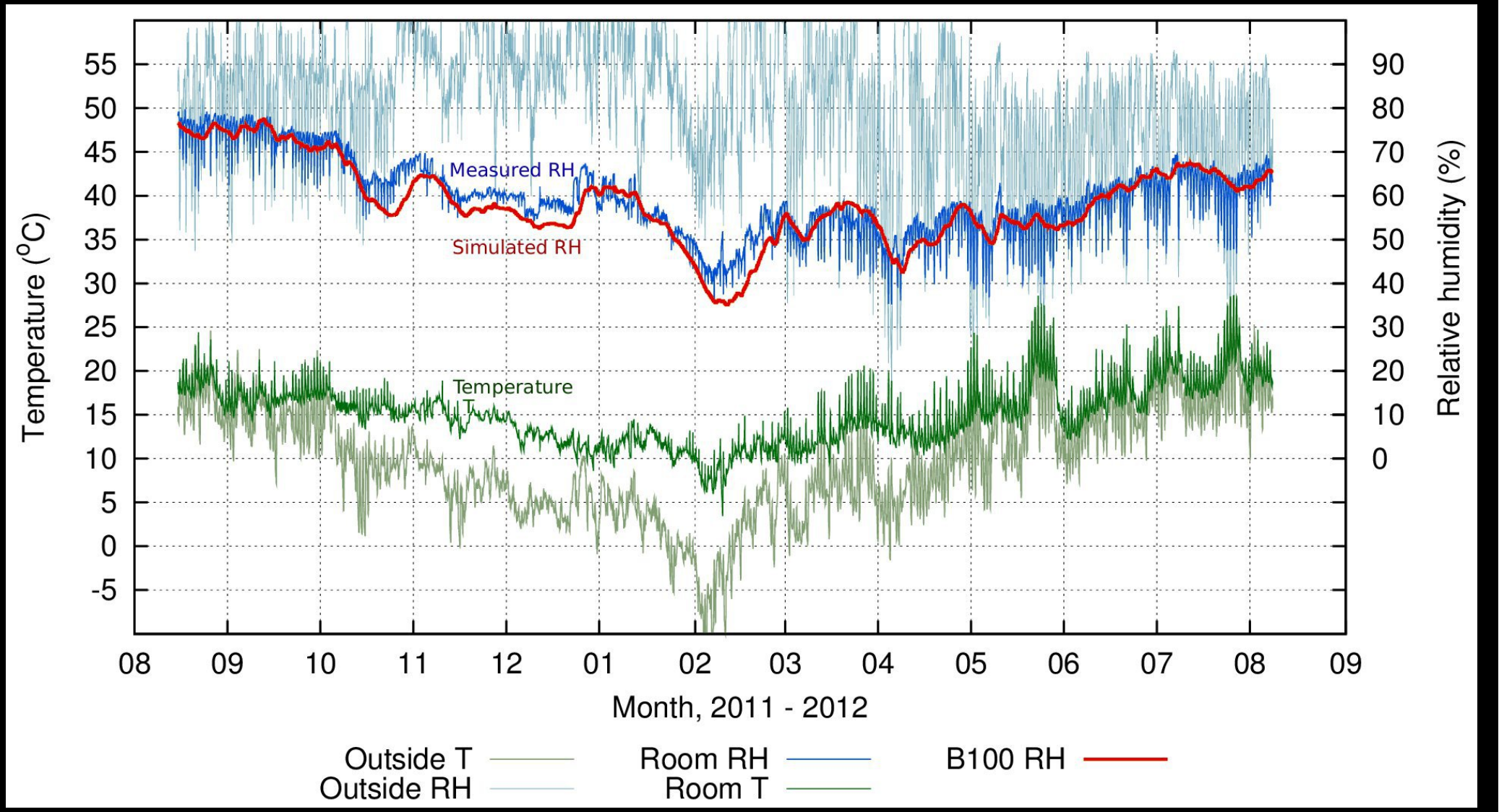
Data from Dominic Wall



The equilibrium between sorbed water in cotton and water vapour in the space around it is scarcely affected by temperature



An experimental room partly lined with unfired, perforated clay brick, as a humidity buffer for stores without much absorbent material in the collection



Temperature and RH outside and within the clay lined room. The red trace is the predicted RH. The spikes are due to direct sunlight temporarily overwhelming the buffer capacity of the clay

Cool storage is defined within this Published Document as temperatures falling between 5 °C and 18 °C.

The RH should be maintained within the range of 30 %RH and 50 %RH in order to be suitable for a cool storage environment.
This RH can be achieved in one of two ways: either through the design and management of the storage room itself or through packaging the relevant documents and thereby creating microclimates.

from PD 5454:2012

There is no mention here that if the 5°C is maintained in summer there will be condensation within the walls - a specialised container is needed. If the temperature wanders between 5 °C and 18°C in an annual cycle, there is no problem.


We must find a better retrieval system – Dogma can't smell in the cold.
FILM ARCHIVE
–20°
wear protective clothing

Cold storage is defined in this Published Document as -15 °C ±5 °C.

The RH in a freezing environment is determined by the level of RH present at the time the document was sealed up inside its freezer packaging.

The maximum RH at which the document formats listed in **4.3.3** should be packaged is 50 %RH.

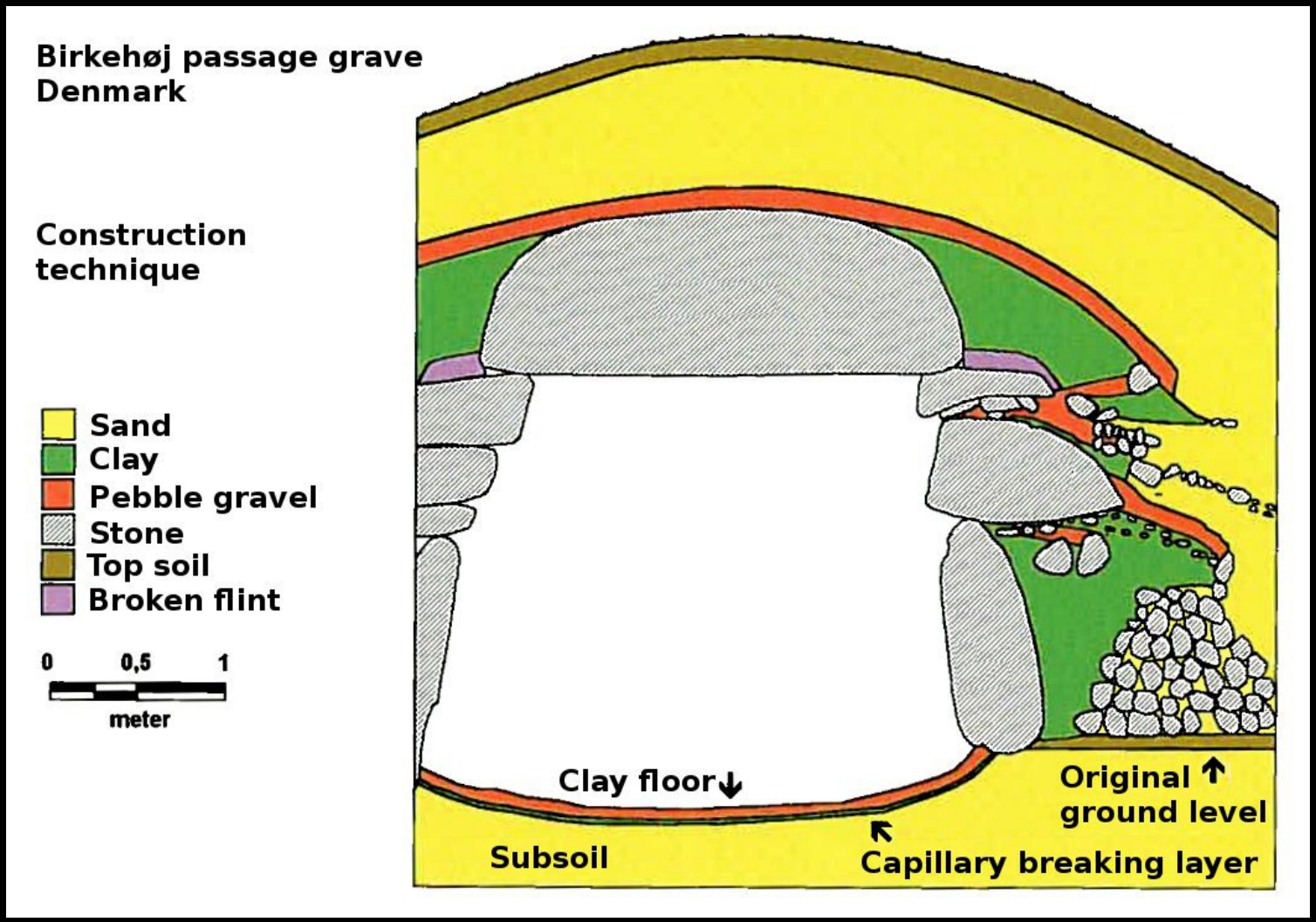
All materials selected for cold storage should be prepared and packaged depending on their type and format. Packages should be sealable and airtight polypropylene or polyethylene bags or boxes.
Humidity indicators should be incorporated inside freezer packaging, along with a humidity buffer that absorbs moisture when archival material is removed from the cold storage environment.

from PD 5454:2012

A further opportunity for the sellers of everlasting packaging for photos:

An instrument for testing the airtightness of each package by subjecting it to a partial vacuum while measuring the rate of descent of the weight as air leaves the package.

The danger of condensation on the object, or on the inside of the container (left) is often a cause of worry to archivists, but it is easily solved



It is humbling to find that building physics and knowledge of materials was applied to the conservation of valued inanimate relics long ago, but 5000 year old birch bark stuffing the cracks was decomposed in the 20th century by fitting a lattice door.

Drawing by Jørgen Westphal

I thank colleagues at the National Museum of Denmark:
Poul Klenz Larsen, Morten Ryhl-Svendsen,
Lars Aasbjerg Jensen and Benny Bøhm.
Data from the Suffolk Record Office is from Dominic Wall,
data from St. Catherine's monastery from Father Justin,
data from Segovia castle from Victoria Smith.
Birkehøj drawing by Jørgen Westphal.

This lecture and an accompanying article which more fully explains some tricky concepts and provides a bibliography, are available at:

www.conservationphysics.org

tim@padfield.dk