Chapter 6

Creating an Environment for Conservation
The Surrey History Centre

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INTRODUCTION

The opportunities offered by National Lottery Funding has focused attention in recent years upon the poor conditions in which much of our written history has to be stored.

The documentary record of each county is held in a record office and pressures on local authority spending have meant that often only basic and sometimes inadequate provision for the safe keeping of the documents has been made.

This paper discusses the environmental conditions for the long term preservation of documents, primarily within archive repositories, and illustrates how they were achieved in the new Surrey History Centre at Woking.

HISTORY

The Surrey History Centre was one of the first major projects outside Central London to be granted funding from the National Lottery Heritage Fund.

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By law, every county in the UK is obliged to provide safe storage of, and public access to, the public record within the county. At the present time, Surrey's public record is stored in four different localities, each with a variety of environmental conditions which is less than ideal. The decision was made to locate the public record on one site, with good storage conditions and good public access.

Surrey County Council also wished to encourage additional visitors/users to the facility (such as educational visits by local schools) by also locating the Local Studies Library and Archaeology Unit onto the site, together with additional lecturing/conference facilities. Funding was provided by the Heritage Fund for these additional enhancements to the scheme.

THE MEDIA STORED

Local Record Offices store 'the record' on a variety of media, today this includes magnetic tape, gramophone records, various types of film, including microfilm, photographs and movies and possibly CD ROM's. However, the most common media have been paper, parchment and vellum, and it was creating conditions for these that was our primary concern for the Surrey History Centre.

Parchment and vellum are made from the skins of animals, mainly sheep, goats and calves, and it has been in use for over 2000 years, (Figure 6.1). All of the hair, fat and flesh are removed from the skins in a series of not very pleasant processes, but leaving a superb surface for writing on. Simplistically, vellum is a thicker form of parchment. Not surprisingly, given its source the quality of the material varies enormously, as does its size. We have had a long association with the Hereford Mappa Mundi which is the largest known single sheet of vellum in the world.

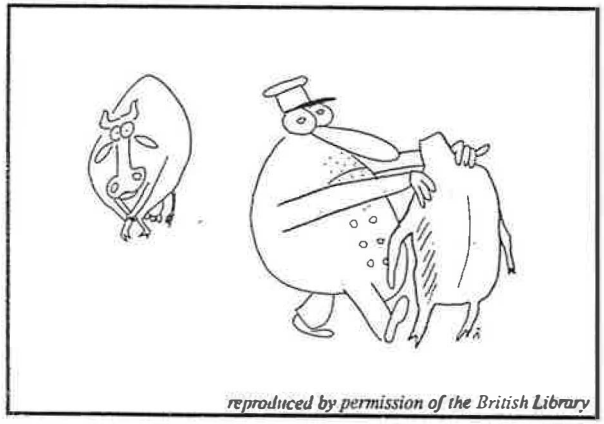

Figure 6.1 **Parchment And Vellum Are Made From Animal Skin**

Paper is traditionally made from the matted or interlaced fibres of linen, and now more commonly from wood pulp. Known to have been used in China in about 100AD it probably reached Europe by the 14th Century and its use greatly increased with the invention of the printing press. Until the 19th Century good quality paper was primarily made from linen rags which have long fibres and produce a durable high quality product. With the introduction of machine made paper using wood pulp, the quality greatly diminished. This has lead to a situation where, invaluable old documents are far more durable than modern ones.

Lastly, we are not concerned with the medium alone, but a composite product, the record itself is written onto the medium in ink of various types, forming a composite structure and placing constraints on how it will be preserved. Books are even more complex structures, of a variety of materials, which can suffer the stresses and strains of differential expansion and in which the pages are tightly packed together.

THE NEED FOR A SPECIAL ENVIRONMENT

The need for special environmental conditions for the preservation of documents are fairly obvious from our own experience. Aside from fire, theft and vandalism, the main risks are:

- biological decay (ie mould growth, insect attack)
- chemical decay (ie embrittlement)
- expansion and contraction
- light
- water damage

I would emphasis here that preservation must be seen on an indefinitely long time scale, whereas we usually judge in human lifespans. By this I mean that, although a document might decay minimally during, say, 50 years, the damage of 500 years may be considerable.

An example I would use is perhaps the most famous document in the world, the Magna Carta of 1215. There were believed to have been 40 exemplars made, that is 40 originals. These were distributed around the country and today only 3½ remain (Lincoln, Salisbury and British Library (1½)). Now we don't know exactly what happened to the others, but one example of the risks may be illustrated by the Lincoln Magna Carta.

Anecdotal evidence shows that it has faded noticeably during peoples' lifetimes; it has suffered water damage in the last 50 years and has been transported to Australia and the United States with the attendant variations in climate, let alone security and other risks.

STANDARDS FOR DESIGN

Statutory responsibility for archives is held by three bodies in the UK; the Public Record Office, the Scottish Record Office and the Royal Commission on Historical Manuscripts. They are empowered to make inspections and base them upon the advice provided in BS5454 recommendations for Storage and exhibition of archival documents.

BS5454 was first published in 1977 after many years of deliberation by experts in document conservation. The current edition was published in 1989. Since then an International Standard has been agreed and is on the point of publication. However, the UK committee responsible for 5454 and input to the ISO standard have decided that 5454 itself should be updated and run in parallel. This is primarily because the ISO, perhaps due to the need for a lot of compromise, does not provide sufficient advice on its own.

BS 5454

The Standard is really about the 'safe storage of documents'(Figure 6.2). It applies to both long and short term storage in restricted access archives and the display of documents in exhibitions.

Parameters to be considered:

- the structure and material of the building
- custody and security
- fire precautions
- environment
- lighting
- storage and production equipment
- packing for storage
- archival material other than paper and parchment
- exhibition
- reproduction of documents.

All of these parameters had to be considered in the design of the Surrey History Centre and each parameter directly or indirectly affects the internal environment. This paper concentrates primarily on air quality.

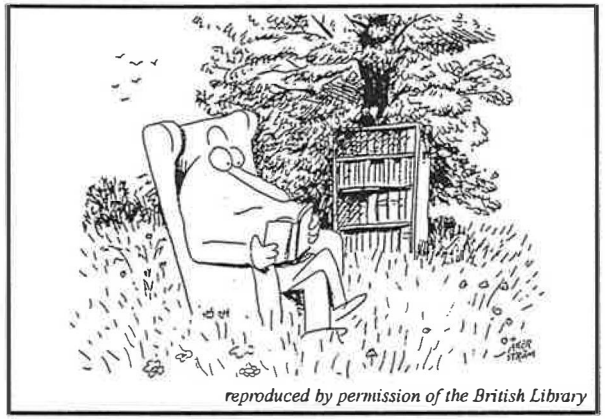

Figure 6.2 'Safe Storage' Of Documents

It recommends that the environment is controlled by either of the following:

- the provision of a building, or compartment within a building, that gives high thermal inertia
- installation of air conditioning that eliminates pockets of stagnant air.

It goes on to recommend that the advantages of installing standby plant be considered

The conditions recommended for archival storage of paper and parchment are:

- Temperature constant between 13°C and 16°C
- Relative humidity constant between 55% and 65%
- Air circulation - 6 air changes per hour
- Fresh air 10%
- Air cleanliness - dust filtration 80% efficiency (BS EN779, F7)
  - sulphur dioxide and oxides of nitrogen $<10\mu g/m^3$.

Noting that a range of conditions is given, what actually should be chosen?

Firstly, an issue that the BS does not clearly address is that any mechanical system must be controlled; thus what we are selecting is the 'set-point' and that the control system will require a proportional-band within which to control.

The temperature range of 5K gives some choice; if we choose a proportional band of ± 1K, we can select a set point of between 14 and 15°C. If we choose a proportional band of ± 5% RH we can only choose 60% as the set point.

This item is probably an oversight in 5454 and is being addressed in the revision, but the most important issue is stability.

Documents are safer the lower the temperature is, but to keep them say close to freezing point means that they could not easily be moved without surface condensation forming and archivists would need to wear thermal underwear, so it is a compromise.

Also the archivist for each collection knows his or her documents best and may well have views on what the best conditions are. Thus for the Surrey History Centre a temperature of 16°C was chosen and a relative humidity of 55% with proportional bands of ± 1K and ± 2.5% respectively. (One important further point of recommendation is that, where there is more than one archive repository, each should have its own air conditioning system to reduce the risk of cross contamination).

The recommended relative humidity was chosen to be as high as possible to keep the documents as flexible as possible but with sufficient margin to minimise the risk of mould growth. Mould spores are in the atmosphere everywhere and growth can be triggered when the relative humidity exceeds about 70% and the risk increases with temperature.

The air circulation rate is intended to be sufficient that, if well distributed, stagnant areas will be avoided.

It is not clear how the 10% fresh air requirement was arrived at but a brief analysis of any design shows that it is probably the minimum that we could provide for the human occupants.

Filtration recommendations include for both particulate and gaseous contamination, and this point implies the use of activated carbon or Alumina filters. In passing it should be said that, because these filters are expensive to buy and maintain, the fresh air supply is best kept to a minimum year round.

PASSIVE OR AIR CONDITIONING?

As stated previously, the BS implies that there is a choice between achieving the conditions merely by 'thermal inertia' or by air conditioning.

Firstly, air conditioning implies that air is heated or cooled to maintain the recommended internal temperature. Cooling requires a refrigeration plant; without this, temperature

control can be achieved in winter by means of a heating system but in summer the best that can be achieved is some 'moderation' from external conditions. Such moderation can be achieved in 'massive' structures, like a Cathedral, and these building designs are become known as 'Green'.

One 'passive' local record office uses this principle and here quite reasonable conditions appear to be achieved by use of a massive structure with a ventilated roof space and wall cavity. However, the achievement of these conditions relies upon dedicated staff who monitor the environment and manually control the ventilation rate. The store is normally unoccupied.

Generally a lower temperature is preferable to a high temperature but temperature stability is also important and ultimately temperature cannot be considered without also considering humidity.

Air conditioning also implies that humidity is controlled. To maintain the recommended levels in the British Standard, moisture has to be removed in the summer and added in the winter.

High humidity, combined with temperatures above the recommended level within a repository will almost certainly result in mould growth; low humidity will dry out and stiffen documents, make them brittle and can lead to flaking of the ink from the surfaces.

Dehumidifiers are commonly seen in libraries and archive stores and the risk of drying out is often reduced by having very low inside air temperatures in winter. A typical heated domestic room or office in winter has a relative humidity of less than half the recommended value for documents of 60%. The passive record office mentioned earlier is provided with dehumidifiers.

Ventilation is that rate at which the air in a room is replaced with fresh air. The BS recommends six changes of air per hour. Without mechanical assistance this can only be achieved by opening windows or purpose made ventilators. In domestic scale buildings it is unlikely that more than two changes of air per hour would be achieved in winter and considerably less in very large buildings, this rate being greatly affected by wind conditions.

A secondary issue is the distribution of air through the space to avoid stagnant areas; this again is difficult to achieve without a mechanical air distribution system.

Air cleanliness can only be achieved by using a mechanical air distribution system where the incoming fresh air can be effectively filtered to remove insects, dust and dirt and micro-organisms.

In conclusion, if air conditioning is not provided the majority of it's components would still need to be provided, ie mechanical ventilation, heating and dehumidifiers.

What cannot be said categorically is that it is not possible to achieve the conditions passively. In fact a recently completed repository in the UK is designed to maintain temperature and humidity without an air conditioning system. However, compromise and an intimate knowledge of the particular collection and location may well allow a wider range of solutions than the BS implies.

For the Surrey History Centre, a hybrid solution was chosen, that is a high thermal inertia structure, isolation of the repository from the outside climate, but also a complete air conditioning system. 5454 recommends consideration of standby plant where the air conditioning solution is chosen, but this was felt to be unnecessary with the hybrid solution.

Light was mentioned earlier as one of the risks to documents. This is due to the effects primarily of UV radiation, and this risk is minimised by avoiding windows and fitting UV filters to lights.

THE CONCEPT FOR THE SURREY HISTORY CENTRE

At the Surrey History Centre in consultation with the archivists, the following temperature and humidity design levels were agreed:

Temperature	2 x Main Repositories:	16°C ± 1°C
	Special (Film) Repository:	13°C ± 1°C
Relative Humidity	2 x Main Repositories:	55% ± 2.5%RH
	Special (Film) Repository:	35% ± 2.5%RH

(A Building Management System at Surrey History Centre also allows authorised staff to interrogate the air conditioning system to indicate the actual conditions being maintained within the repositories and produce an alarm to indicate mechanical plant failure).

The building itself splits very neatly into three different functions:

- public
- storage
- staff

These functions were used to develop the layout of the building itself, (Figure 6.3).

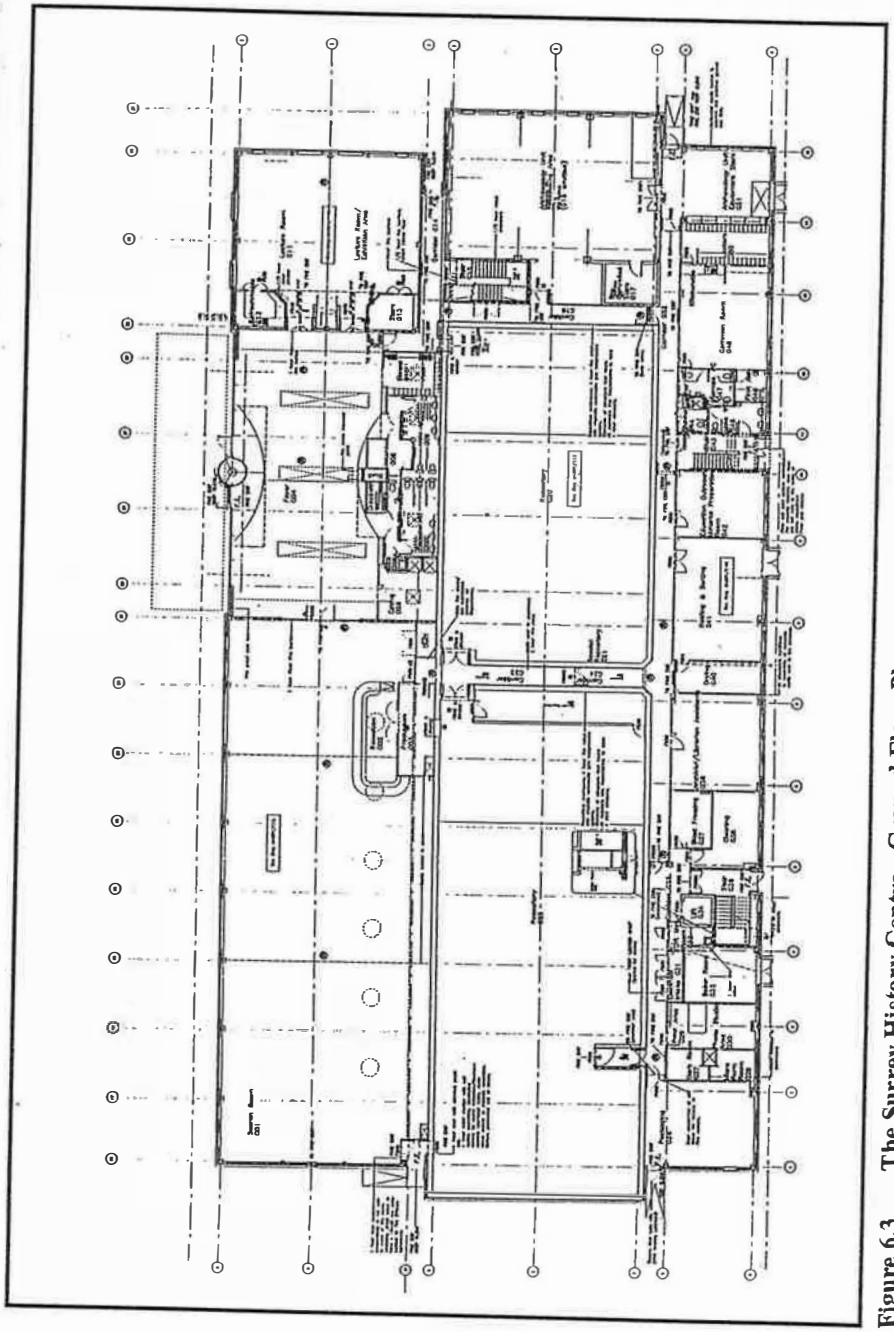

Figure 6.3 The Surrey History Centre - Ground Floor Plan

The north side of the building is mainly for the public, where members of the public arrive to use the Search Room (where they may already have ordered documents from the repository to research) to use the Lecture Room (eg educational visits) or to visit the Archaeology Unit. This arrangement also allows the provision of good daylighting.

The centre of the building houses the repositories where the public record is stored. The repositories are protected on each side by the public and staff areas.

The south side of the building is mainly for the staff, both their offices and the conservation workshop and cleaning and processing facilities for the documents. Any new documents, on arrival are brought directly to the back of the building to be unloaded, cleaned and packaged before storage within the repositories. Some will also be repaired at this stage, others at a later date.

SURREY HISTORY CENTRE - THE ENVIRONMENT

In order to ascertain what environment should be provided within the new centre, it was necessary to categorise the building. For instance, the temperatures recommended for storage of documents are much lower than those for normal human comfort.

In addition, to provide very close control of conditions throughout the whole building would have been very expensive.

The categories chosen were therefore as follows:

Areas Where Archival Material Is Stored Permanently
Compliance with BS5454.

Areas Where Archival Material Is Used Or Worked On
In these areas, eg Search Room, Conservation Laboratories, the comfort of the users must be considered alongside the needs of the documents. Therefore, the temperature is maintained slightly higher than in the repositories, but the humidity level is maintained at the same level as the main repositories. The tolerance band of the control system is slightly larger than for the repositories. UV filtration is provided to all lighting and glazing in these areas.

Areas For Public Or Staff General Use
In these areas, eg staff offices, lecture rooms, the needs of the users take precedence, as in a more conventional building, (Figure 6.4). No humidity control is provided and the budget did not allow for all

of these areas to have cooling. Instead, the lecture rooms have cooling but the remainder of the rooms are provided with solar shading and natural ventilation to prevent excessive overheating in summer.

Ancillary Areas
Areas such as the toilets and corridors were provided with heating and mechanical ventilation much the same as a conventional building.

SURREY HISTORY CENTRE - THE STRUCTURE

In order to negate the need for standby plant and reduce air conditioning cooling loads, it was decided to create a high thermal inertia structure for the repositories. In more simple terms, a high thermal inertia structure is basically a 'massive' structure, like a cathedral, that has such a resistance to heat that it takes a very long time for the heat to pass through.

Heat is only transferred when there is a difference in temperature. Therefore, in summer, with a conventional structure heat would transfer quickly from the warm environment outside to the much cooler environment inside, quickly raising the internal temperature

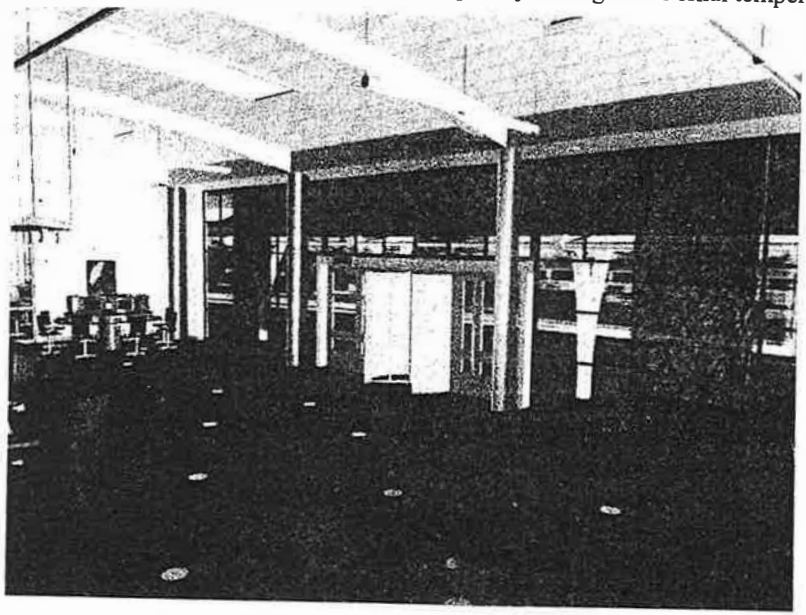

Figure 6.4 The Surrey History Centre - Reception

or imposing a greater load on the air conditioning system. A massive structure, however, delays the time that it takes for the heat to travel to the inside. By careful design, we can predict this delay or time lag so that, before the heat gets to the inside of the building, night has fallen and the outside temperature has dropped causing the heat within the structure to transfer back to outside.

For the Surrey History Centre we designed a 'massive' structure which also has a ventilated cavity. The outer brick skin allows heat to transfer fairly quickly through to the cavity where it is drawn up through the cavity by stack effect and away from the inner 'massive' skin. In this way we hope to prevent a gradual build up of heat within the repository over the summer months.

The repository roof is designed as a double roof. The inner roof is again a 'massive' structure and is fully waterproofed. The outer roof is a lighter metal roof which acts as a sun shade to the inner roof and is weatherproof, to provide first protection against rain. The space between the two roofs is fully ventilated, again to take heat away from the inner 'massive' structure. As this roof construction was quite costly it was decided to use the ventilated space between the two rooms as the main plantroom, which has proved very successful.

Standby plant is not needed with this type of construction because, if any item of air conditioning plant fails, the whole plant is automatically switched off. The doors of the repository are then shut and nobody is permitted to enter the repository until the air plant has been fixed. In theory, the repository should be able to maintain reasonably stable conditions, close to the ideal for 2-3 days. Because the air change rate is reduced to a minimum, the humidity level should also remain fairly stable.

The remainder of the building uses a more conventional construction but is protected from high heat gain in summer by large overhangs and fixed solar shading, which also doubles as a window cleaning platform.

Another successful feature has been the use of north lights in the Conservation Workshop and the Archivist and Librarian Area and general offices at first floor level. The use of north light, ie indirect natural daylight, has given a very pleasant feel to these spaces whilst not compromising the needs of the documents being worked on within the spaces.

OPERATION AND MAINTENANCE

Of course, there is no point in installing sophisticated systems if they do not operate properly. BS5454 refers to the need to provide proper routine maintenance, in particular of the air systems. It also clearly states that the need to keep the air conditioning system clean should be taken into account during the design.

The systems installed within these buildings must operate very close to the limits of the psychometric process and within tight performance parameters. A system which is not regularly maintained risks not only increasing operating costs but also risks damaging the media being stored, which is unacceptable.

At Surrey History Centre the air handling plant has been located within the plantroom with careful consideration to space for access; filters in particular need regular inspection, in order to ensure that the air systems remain clean and that entry of unwanted contaminants is prevented. In addition, because the centre is run by the County Council it will have a proper maintenance regime provided by a carefully selected maintenance contractor.

The importance of a proper maintenance regime cannot be over emphasised; the users of this type of building will immediately know if the systems are not performing but cannot (and should not) be expected to rectify the situation themselves.

However, the staff need to be aware of the design intention of the building. The staff at Surrey History Centre were well informed throughout the design process and now understand the reasoning behind having a thermally massive structure. They know that certain procedures should be followed if the plant fails (ie that the repositories must be shut and nobody should enter until the plant has been fixed), but they also know that they should not attempt to 'fiddle' with the plant themselves. Obviously, the 'proof of the pudding, will be in the eating'. Hopefully we shall never have to find out!

CONCLUSION

The completed Surrey History Centre was handed over to Surrey County Council last month and the task of moving in all the documents has begun. The planned opening date is in October of this year.

RESOURCES:

Caring for Books and Documents: A D Baynes-Cope - The British Library

BS5454: 1989 : British Standard Recommendations for Storage and exhibition of archival documents

Archive Buildings in the United Kingdom: Dr C Kitching - HMSO