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Energy Savings and Preservation in Libraries and Archives

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Light more, consume less!

Saxoléine. Pétrole de sûreté, Jules Chéret (1836-1932).
© BnF/Dpt of Prints and Photographs.

This is the slogan chosen for the 2011 edition of Lyon's Festival of lights which the "Malmö Lamp", featured on the issue cover, was one of the artistic installations on display. If, in a time of economic crisis, energy consumption is everywhere high on the agenda, it is even more crucial for cultural institutions. Libraries, archives and museums do not intend to renounce their core missions through throwing enormous budgets into increasing energy costs. The last example to date is the decision taken by the The Louvre to cut down on by 73% its electricity consumption by using LED technology for its outdoor lighting.

The selection of articles in this December issue is a brave attempt to live up to the motto of the Lyon festival and adapt it to our problems: "Preserve better, consume less!" I would like to thank May Cassar, Director of the Centre for Sustainable Heritage (University College London), who kindly accepted to launch this dossier and share her experience with us.

Preservation benefits today from research projects and new technologies to adapt and manage climate conditions in storages at the lowest cost possible. Thus, experts at the Image Permance Institute (Rochester Institute of Technology, Rochester, NY) have analyzed the consequences of a monitored and limited shutdown of the air handling units within 5 major American libraries in terms of energy savings and preservation. In the same way, the UK National Archives have mapped their storage facilities in order to reduce energy costs by using a building environment simulation software.

If energy consumption is now taken into account at an early stage of site planning, as it is the case for the Archives nationales de France new site in Pierrefitte-sur-Seine, it is nevertheless difficult to find satisfactory solutions for historic or already-existing buildings. The European project 3ENCULT tries to address this challenge.

Those initiatives, usually undertaken in temperate climates, benefit also to new constructions in tropical climates although adjustments are required as the architectural project for the new Territorial Archives of Saint Martin in the French West Indies illustrates it.

We wish you all a good reading and a Happy New Year 2012.

Christiane Baryla
Directeur d'IFLA-PAC

Bec Auer, incandescence par Gaz-pétrole, 1895,
Charles Verneau. © BnF/Dpt of Prints and Photographs.

Light more, consume less!

Tel est le slogan de la Fête des Lumières à Lyon dont la Lampe de Malmö, en couverture, fut l'une des installations. En ces temps de crise économique, la consommation d'énergie est par tout à l'ordre du jour, notamment dans les institutions culturelles. Bibliothèques, archives et musées ne veulent pas renoncer à leurs missions en engloutissant des budgets énormes dans l'énergie. Dernier exemple en date, le Louvre va réduire de 73% sa consommation électrique en utilisant de nouvelles ampoules LED pour son éclairage extérieur.

Dans ce numéro, nous tenterons à travers les articles présentés d'adhérer au mot d'ordre lyonnais en l'adaptant à nos préoccupations : « Préservons mieux, Consommons moins ! »
Nous remercions chaleureusement May Cassar, Directrice du Centre for Sustainable Heritage (University College London), d'avoir accepté d'introduire ce dossier en nous faisant partager son expérience.

La conservation bénéficie aujourd'hui de projets de recherche et de nouvelles techniques pour gérer les conditions climatiques en magasin à moindre coût. Les experts de l'Image Permanence Institute (USA) ont analysé les conséquences d'un arrêt contrôlé et limité des unités de traitement de l'air dans 5 grandes bibliothèques américaines, en termes d'économie d'énergie et de conservation. De la même façon, les Archives nationales du Royaume Uni ont cartographié leurs magasins afin de réduire leur facture énergétique à l'aide d'un logiciel de simulation des conditions environnementales.

Si la consommation d'énergie est désormais prise en compte dès la programmation d'un bâtiment, comme c'est le cas du nouveau site des Archives nationales de France à Pierrefitte-sur-Seine, il est toutefois plus difficile de trouver des solutions satisfaisantes pour les édifices anciens ou déjà construits, problématique à laquelle le projet européen 3ENCULT tente de répondre.

Ces expériences réalisées généralement en climat tempéré profitent également aux nouvelles réalisations en milieu tropical, bien que de multiples adaptations soient nécessaires. C'est ce que nous montre le projet de construction des Archives territoriales de Saint Martin aux Antilles Françaises.

Nous vous souhaitons une excellente lecture et une très bonne année 2012 !

Christiane Baryla
Directeur d'IFLA-PAC

Energy Reduction and the Conservation of Cultural Heritage: a Review of Past, Present and Forthcoming Initiatives

by Professor May Cassar, Director, Centre for Sustainable Heritage, University College London, UK

For almost two decades, research and practice have sometimes together, but more often separately, considered ways in which energy efficiency can be improved in museums, galleries, libraries and archives without causing damage to collections or the buildings in which they are housed.

While it is widely recognised that cultural heritage is an environmental good that needs to be sustained for the future, curators and conservators, librarians and archivists have the responsibility to engage in the process of adaptation to climate change through energy reduction.

There are a growing number of examples of buildings, particularly of existing dwellings of character that have been renovated to improve their energy efficiency. Against this background, the adaptation of historic public buildings housing museum, gallery, library and archive collections has generated many exchanges among heritage staff and experts in building science, and a number of international guidelines and standards are being developed.

"Yet progress towards finding solutions that balance heritage and energy conservation has ebbed and flowed over the years."

Yet progress towards finding solutions that balance heritage and energy conservation has ebbed and flowed over the years. This paper examines advances in knowledge, considers the tension between energy reduction and the conservation of cultural heritage and explores how the behaviour and attitude of those involved is influencing progress.

Management Priorities for Environmental Control and Energy-Efficient Practice in Museums

In 1994[1], six rules of thumb were proposed to help develop or review good practice in environmental control and energy efficiency when planning or renovating a building or installing or upgrading new environmental control equipment. In all these areas it was suggested that *good design, careful execution and competent management* are required in order to realise worthwhile benefits.

"Do simple things first:

When planning a new building, be prepared to ask for low-energy features. They are often simple and straightforward! Before renovating an existing building, find out how energy is being used and identify where energy-savings can be made. You may find that the priorities are not quite what you thought!

Adapt the appropriate Standards, Codes and Guidelines to your particular situation:

Do not adopt published recommendations wholesale. Accept that in the interest of energy efficiency, the building can be allowed to ride seasonal fluctuations without putting the collection at risk, by permitting a gentle drift between summer and winter temperature and humidity conditions.

Carry out energy-efficiency improvements thoroughly:

It is important to look not only at upgrading equipment with more energy-efficient appliances, but also at whether building improvements can exploit rather than replace intrinsic low-energy features in the original building. Retain and develop the good features, such as wooden window shutters, and eliminate or minimise the bad ones, such as large areas of single-glazing.

A significant reduction in energy costs is usually possible if better equipment and controls are accompanied by improvements to the building's air-tightness, glazing and insulation.

Be aware that improvements to the fabric may give disappointing results if services and controls are not altered (or at least adjusted accordingly).

In new services design, consider ducting conditioned air from areas needing high-quality control to areas that can make do with a less stringent specification, for example, from air-conditioned galleries and stores to public spaces.

Consider the various uses of space within the building:

By moving different functions around, advantage can be taken of the natural environmental characteristics of the building and reduce lighting, heating/cooling and ventilation loads.

For example, collections in storage do not require daylight or natural ventilation, while occupants of a building do. Therefore, it makes sense to place people near the perimeter of the building, while collections are housed more centrally.

1. Cassar, M. 1994. *Museums Environment Energy*, HMSO: London, pp.127-129.

Use appropriate technology to service the building:

Building services should be installed and operated in harmony with the building as a whole. For example, excess heat should be exhausted or redistributed rather than fighting it with refrigeration.

For the most reliable results, advanced technology should be used as a direct replacement for conventional technology. For example, condensing boilers should be used as a direct replacement for conventional boilers and high-frequency light fittings should replace low-frequency light fittings.

It is worth remembering that, where possible, the installation of intrinsically efficient appliances is usually preferable to new pieces of equipment being added to improve to old technology.

Operate and control environmental equipment effectively:

A control system must not be so complex that the museum is unable to operate equipment with the skills available to it in house. The importance of training and discussion are vital to ensure that everyone knows how the controls are supposed to work and what the reporting lines are in case of failure.

"It was accepted that museums need to approach long-term collections care in a way that does not require excessive use of energy, whilst recognising their duty of care to collections"

Sub-metering can be useful in specific areas, such as the restaurant and for energy-intensive items of equipment, such as fans and steam humidifiers. This gives management information on running costs of different areas and particular items of equipment. The status of equipment and alarm conditions should also be clearly indicated.

It has been stated that 20% of the effort produces 80% of the results. Therefore it is better to ensure that high-priority measures are done well and avoid a mass of marginal features that only give the appearance of improvements.

However, none of these measures will make a significant impact on the operating costs of a building if they are carried out in isolation, outside a management framework. For cost-effective improvements, determination to carry these measures through must exist within the senior management structure of the museum."

This guidance has focussed on improvements in energy appliances and environmental management. Its aim was to reduce the amount of energy being used without the need to alter museum environmental specifications or necessitating intrusive changes to the building fabric. This guidance has stood the test of time and is a robust predecessor to our current obligation to reduce our overall carbon footprint. Replacing fossil fuels with other forms of energy while still consuming the same amount is not a sustainable strategy – we need to learn to make do with less. The guidance which focussed on taking simple steps first, on adapting standards to the local situation, on being thorough, on managing space, on using appropriate technology and on operating environmental equipment effectively was not contentious possibly because it did not challenge tight conservation-led environmental specifications. It did not spark a debate. It is possible that the advice was ahead of its time. It was almost forgotten until recent events re-ignited interest in what was now perceived as the double standard of caring more for our cultural heritage and not enough for the impact of our specifications on the global environment.

The National Museums Directors Conference Guiding Principles for Reducing Museums' Carbon Footprint

In 2009, the Directors of Tate and the Victoria and Albert Museum convened a group of UK conservators and other stakeholders to review museums' environmental conditions against a background of energy constraint on behalf of the Bizot Group[2].

There were two main drivers for this initiative: the escalating costs of running energy intensive facilities and the desire of the Bizot Group to consider whether tight environmental controls for the loans of exhibits could be relaxed in order to reduce the amount and cost of energy. The debate on the need for energy constraint by museums was broadly welcomed by conservation professionals. It was accepted that museums need to approach long-term collections care in a way that does not require excessive use of energy, whilst recognising their duty of care to collections. There was general agreement that time had come "to shift museums' policies for environmental control, loan conditions and the guidance given to architects and engineers from the prescription of close control of ambient conditions throughout buildings and exhibition galleries to a more mutual understanding of the real conservation needs of different categories of object, which have widely different requirements and may have been exposed to very different environmental conditions in the past"[3]. As a first step, it was proposed that museums adopt guiding principles[4] in rethinking policy and practice with the aim of minimising energy use. Three unique features in this initiative stand out: it was led by museum directors; it focussed on international loans and it excluded all other operational uses of energy by museums, their suppliers and service providers, which added together will on average amount to more than the energy consumed to control the environment around collections.

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2. Bizot Group: also known as the International Group of Organizers of Large-scale Exhibitions, comprising the world's leading museums and galleries.
3. NMDC guiding principles for reducing museums' carbon footprint: http://www.nationalmuseums.org.uk/media/documents/what_we_do_documents/guiding_principles_reducing_carbon_footprint.pdf (accessed 14.01.2012).
4. *Ibid*.

Smithsonian Institution

Those involved in the most recent debates on relaxing tight environmental control specifications will be aware of the controversy that followed the announcement in August 1994 that research by Smithsonian Institution scientists had led to guidelines for climate control in museums and archives to be revised. In rejecting the "ideal" environmental conditions of 20°C and 50% RH, they claimed to have found that museum objects can safely tolerate as much as 15% fluctuation in RH and as much as 10°C difference in temperature. This new insight, they declared, could save museums millions in construction and energy costs needed to maintain environmental conditions once considered essential for the protection of artefacts[5].

"The reluctance to change and notably to relax environmental specifications is due to the paucity of knowledge on the likely damage change will cause to objects."

While scientific research on the environmental causes of damage to objects was used as evidence here to explain the potential benefits of changes in environmental specifications, other scientific evidence was produced to demonstrate the dis-benefits of such changes. So while science was used as evidence, it was not conclusive for decision-makers. What is interesting also to observe is that directors of cultural institutions had become involved in scientific debates and had taken the lead from the scientists and conservators.

International Institute for Conservation Round Table on Climate Change and Museum Collections

In 2008, the International Institute for Conservation focussed its attention on environmental standards and energy efficiency in the frame of concerns over mitigation and adaptation to climate change. At Round Table on 'Climate Change and Museum Collections'[6], it was proposed that changes to environmental specifications should be based on understanding the risks to objects through the use of damage functions. Damage functions are used by scientists working on outdoor cultural heritage to express quantitatively the damage induced by climate parameters on building materials. Most of the damage functions that exist for cultural heritage relate to outdoor conditions. So how do we make progress in developing damage functions for museum materials? As stated in the Round Table discussion:

"Conservators have the best knowledge of the physical state of collections and which materials best represent a collection, using data from condition surveys, to work out the risk of damage. This is a good starting-point for developing damage functions for museum materials. Conservators and scientists, together with curators, need to work together to develop damage functions for a range of collection materials. Once we have these, we can model the links between damage and the environment, and then the environment and energy."

This statement hints at one of the underlying causes of tension between energy reduction and the conservation of cultural heritage. The reluctance to change and notably to relax environmental specifications is due to the paucity of knowledge on the likely damage change will cause to objects. Research, especially the development of damage functions for organic materials such as wood and paper-based objects is in its infancy. In 2011, considerable effort was made to assemble the available research data as part of the development of a new specification for environmental conditions for cultural collections being developed by the British Standards Institution with sponsorship of The National Archives at Kew in the UK, The Collections Trust, CyMAL Museums Archives and Libraries Wales, a division of the Welsh Assembly Government and The Museums, Libraries and Archives Council (MLA) now Arts Council England.

PAS 198: 2012 Specification for Managing Environmental Conditions for Cultural Collections

PAS 198 is intended to help collection managers by specifying requirements for environmental conditions for cultural collections, in storage, on display or on loan in order to minimize damage to items caused by inappropriate environmental conditions. What distinguishes PAS 198 from other specifications is its evidence-led approach that allows for risk-based decision-making in the management of environmental conditions and the need for a more responsible use of energy. In 2009, the Science and Heritage Programme[7] Research Cluster 'Environmental Guidelines Opportunities and Risks (EGOR)[8] investigated the appropriateness of current environmental guidelines, standards and targets for the conservation of cultural collections in the context of global responsibility. One of the main outcomes of EGOR was a strong recommendation that new environmental standards should be developed reflecting recent scientific evidence, which would be appropriate for cultural collections in the UK. What the process of developing PAS 198 revealed was the need for compelling qualitative and quantitative evidence to support decision making. The response from the conservation community was that environmental management is not just about 'science' – "after all we see the effects of inappropriate environmental standards on collections". The challenge therefore to the conservation community is to publish their observations and in doing so subject their experience to peer scrutiny like all other professionals. The body of quantitative scientific evidence and qualitative observations need to be in-

5. Smithsonian Institution. 1994. "Work of Smithsonian scientists revises guidelines for climate control in museums and archives." In *Abbey Newsletter*. 18/4-5, 45 (accessed 14.01.2012).

6. International Institute for Conservation. *Climate Change and Museum Collections*, 17th September 2008, The National Gallery, London. http://www.iiconservation.org/sites/default/files/dialogues/climate-change-en.pdf (accessed 15.01.2012).

7. Science and Heritage Programme: http://www.heritagescience.ac.uk/ (accessed 15.01.2012).

8. Science and Heritage Programme Research Cluster. *Environmental Guidelines: Opportunities and Risks (EGOR)*: http://www.nationalarchives.gov.uk/information-management/projects-and-work/environmental-guidelines-opportunities-risks.htm (accessed 15.01.2012).

dependently reviewed and tested so that sustainable decisions can be reached on appropriate environmental conditions for a range of cultural heritage.

CEN/TC 346

The most well-known initiative currently in progress is the development of a new European standard on the protection of objects in all types of collections, the CEN/TC 346 [9]. It will take on board the latest thinking on environmental criteria and update advice on building construction and protection, fire precautions, storage and packing requirements, modern media and exhibitions. This work should be completed by 2013/14.

Conclusion

The initiatives described in this paper can be grouped mainly under standards or guidance. The process to develop them over the last twenty years has been iterative, characterised by review and some progress. Scientific evidence is increasingly used as evidence to underpin changes in specification, though the main impetus for the changes has been the pressure to reduce energy consumption globally. The question that needs answering now is how prepared and willing are the conservation academy and practitioners to debate these changes in order to ensure that decisions over changes to environmental specifications are robust, authoritative and broadly supported.

9. European Committee for Standardisation, CEN TC/346 – Structure: http://www.cen.eu/CEN/Sectors/TechnicalCommitteesWorkshops/CENTechnicalCommittees/Pages/TCStruc.aspx?param=411453&title=CEN%2FTC+346 (accessed 15.01.2012).

Research on Energy Savings Opportunities in Libraries

by Jeremy Linden, Preservation Environment Specialist, Image Permanence Institute,
Rochester Institute of Technology, Rochester, NY, USA

Abstract

The specific research question investigated in this project is whether energy usage can be significantly reduced by carefully monitored and risk-managed shutdowns of Air Handling Units (AHUs) during unoccupied hours in selected spaces without compromising the quality of the preservation environment. In addition, the research involves several subsidiary questions:
- *What are the best ways to define and identify collections spaces that are good candidates for shutdowns?*
- *What tools are needed to measure energy use and the effects of environmental changes on the conditions of collections?*
- *What procedures for collaboration among facilities and library/preservation staff are required?*
- *What other barriers to implementation exist?*
- *What kinds of tools and protocols are needed for libraries to carry out these approaches without outside help?*

In addition to methodology and early results, this paper will discuss lessons learned to this point in the research process, unexpected findings, and the potential impact in cost-savings of these practices.

1. Sterling Memorial Library at Yale University. The main stack tower is one of the experimental sites for the project.

Introduction

Research has shown that environmental conditions (temperature and relative humidity) are the most significant factors impacting the lifespan of cultural materials held by institutions. Mechanical systems in library environments are therefore frequently designed to run continuously in order to maintain the desired environmental conditions, often resulting in a high cost both monetarily and in energy consumption. Altering these conditions through changes in HVAC operating schedules is a risk many librarians and institutions are hesitant to take. The Image Permanence Institute (IPI) and our energy-consultant partners at Herzog/Wheeler & Associates, undertook a three-year research project beginning in November 2009 to inspect the hypothesis that energy usage in libraries and cultural institutions can be significantly reduced by carefully monitored and risk-managed shutdowns of air-handling units during unoccupied hours in select spaces, without compromising the quality of the preservation environment.

The partners for the research project are Sterling Memorial Library at Yale University in Connecticut, the Southern Regional Library Facility and the Young Research Library at the University of California in Los Angeles (UCLA), the Bryant Park Stack Extension at the New York Public Library (NYPL) in New York City, the Library Annex at Cornell University in Ithaca N.Y., and the main stacks of the Birmingham Public Library in Birmingham, Alabama.

Methodology: Candidate Space Selection

Gathering data on the viability of mechanical system shutdowns as energy-saving strategies in storage areas with sensitive temperature and relative humidity needs required a sample set that was not only manageable for the amount of work, but representative of the various climatic conditions and library construction found throughout the United States. Selection criteria included:
- Geographic Location
- Institution type
- Storage model – traditional stacks, high-density modules, individual rooms
- "Interior" and "Exterior" wall exposure
- Single or multiple identifiable air handlers serving the space
- HVAC zone dedicated to collections storage
- Level of human occupation during day

These factors provided a variety of starting conditions and a range of challenges to the successful implementation of a preservation-conscientious shutdown.

Geographic location and outdoor weather trends were the first significant factor. Partners in coastal southern California, coastal New York and Connecticut, upstate New York, and Alabama provide various challenges to the hypothesis. Can a shutdown be successful in the high temperature and humidity conditions of summer in Alabama? Will a system be able to recover to its temperature and relative humidity set points during cold winters of the Northeast U.S.? In addition, we recognized early in the project that institution and library type would play a role in the potential viability of the strategy. In the United States, there are often key differences between various types of libraries, and our selection of both university and public libraries satisfied our requirements for testing the project within different administrative and physical infrastructures.

The layout of library storage, the location of storage within a building, and the actual space utilization, all had an impact on the creation and maintenance of a particular environmental condition – and, in turn, on the reaction to a shutdown experiment. Large, traditional stack structures such as those at Yale and Birmingham Public Library often have a much smaller volume of collections compared to air volume in the space than do purpose-built high-density storage areas, such as the high-density storage at Cornell and UCLA. In high-density storage areas, there is a greater possibility that the collection, once at equilibrium, could exert some influence by serving as a heat-sink and moisture buffer during short-term environmental changes. In addition, the amount of exterior wall exposure a space has can influence the likelihood that outdoor climate conditions will have an impact on the indoor climate during a shutdown period. Spaces with little to no exterior wall exposure, or spaces surrounded by other conditioned spaces, are less likely to be influenced by outdoor conditions.

Each test space had to be served by one or more identifiable air-handling units (AHUs) that created the preservation environment. Most of our test spaces are served by a single AHU that operates on its own to create the specified temperature and relative humidity set points. Understanding the effect of a system shutdown in these spaces should be relatively straightforward, barring unforeseen external influences. In the case of the Sterling stacks at Yale, there are actually six different AHUs serving the stack tower, in conjunction with a hot-water perimeter heat system, making assessment of the shutdown experimentation more difficult. One goal of the test space selection was to ensure that the AHUs we are working with serve a zone (the physical area that the unit creates the environment for) dedicated to collections storage. Mixed-use zones, which include both collections storage and office space, were avoided in order to remove the influence of human comfort concerns from the experiment as much as possible. For each test location, we estimated the timing of peak human activity in the space and sought to schedule shutdowns during low-activity periods, typically at night.

Methodology: Data Collection

Successful analysis of the ability to use system shutdowns to save energy without negatively affecting preservation quality requires the availability of measured temperature and relative humidity data from both the collections storage area and the mechanical system. The goal of data collection within the space is to gather a baseline of information about the preservation environment that allows for the quantitative comparison of existing conditions without shutdowns, to new conditions that include the system shutdown schedule. IPI's Preservation Metrics™ were used to quantify the preservation quality of each storage space. Analysis of collected data also identifies how quickly conditions within the space change when conditioned air is not constantly provided, whether the collection itself may be exerting any control over temperature and relative humidity, and whether or not a previously unidentified source of heat or moisture exists in the storage area.

Calculations of the impact of shutdowns on energy consumption are based on data typically logged at five points within the AHU, depending on system type. Conditions are measured at the outside air intake, the return air from the space, the mixed outside and return air stream, the cooled or dehumidified air, and the heated or reheated supply air. These datasets are compared to one another to determine the amount of work done by each component within the AHU. In addition to strict temperature and relative humidity data collection within the unit, the amps used at electric devices and logged – typically from supply or return fan motors or electric heat or reheat coils – in order to measure the rate of energy consumption by these devices.

The majority of monitoring in the collections spaces and the mechanical system is done using IPI's PEM2™ dataloggers. HOBO loggers are used to collect electrical data and ACR loggers are used in condensing environments.

2. The high-bay, high-density stacks at the Library Annex at Cornell University, one of the experimental sites for the project.

3. One of the AHUs at the Library Annex at Cornell University. Project partner Peter Herzog of Herzog/Wheeler & Associates is shown.

Methodology: Experiment Design

IPI worked with each research partner to develop the shutdown schedule. The actual shutdown design considered several factors:

- The need to limit the number of variables
- Recognition of the general trends of outdoor conditions
- Respect for human comfort requirements in the space
- The need for accurate comparative data
- A desire to achieve meaningful energy savings
- Most importantly, the protection of collections from any undue risk

As a result we settled on a number of guidelines for experimentation that we tried to keep constant for all research partners. At each location we gathered three to six months of baseline environmental data from both the storage space and the AHU. This provided "as-is" operational data for initial analysis and later comparison. Before implementing the shutdown schedule, this data was reviewed to determine whether conditions were already harmful, or if the system was not controllable, giving us an opportunity to cancel the experiment at that location if necessary.

Once the baseline data was collected and reviewed, we instructed our partners to begin a one-month shutdown test period designed to identify any potential system or environmental problems with the shutdown parameters before the shutdown experiment began. The test period was used to determine if the AHU could handle the shutdown without experiencing a mechanical failure, if the shutdown pattern was correctly programmed into the controls system, and whether drastic changes in space conditions from unforeseen heat loss or gain might occur. All research partners completed both the baseline data collection and experimental shutdown period without complication.

Our goal was to experiment with 7 to 10 hours of total shutdown time for each 24-hour period at each test location, generally conducted over night. The time selected provided the greatest potential for significant energy savings, and the selection of nighttime hours lessened the possibility of human comfort issues. In addition, shutdowns during typically cooler evening periods would lessen potential swings in environmental conditions. One exception to this model is Cornell University, where our partners requested that we experiment with scheduling four hours of the total shutdown period (50%) during the middle of the day when their electrical demand rates were the highest.

Once the one-month shutdown test period was successfully completed, we moved on to the full 12+ month experimental period. Data is gathered and analyzed approximately once per month during this period, and with greater frequency in spring and during other seasonal transitions.

Methodology: Administration

Previous field research has taught us that administration of the project at each partner institution requires a primary contact and "champion" for the experiment. In this experiment, our primary contacts are all librarians or collection managers, four of whom have preservation as a direct responsibility. Due to the nature of the experiment – adjusting the operation of the mechanical system while protecting the collections – we are operating within multiple administrative structures in most institutions, and therefore need the input, commitment, and cooperation of all individuals and departments involved. Successful conduct of the experiment requires the participation of collections and facilities staff, as well as the approval and commitment of the administration.

Representatives from these groups at each institution worked together as a team to develop project design and methodology with IPI, to determine the most appropriate candidate spaces, to identify the proper channels to work through to make adjustments to mechanical system controls, and to finalize the work plan for data gathering and analysis at each site. As a result, the collections staff at each partner institution knows who to contact if they find that the experiment schedule is not happening, and the facilities staff knows to contact the collections staff if there is a malfunction or planned maintenance that will create a departure from the experiment schedule.

Early Results

The final shutdown schedules for experimentation were put into place at most partner sites between November and December 2010. Through the early summer of 2011, the results of analysis of the experimental data have been generally positive. Where the shutdown schedule is progressing as planned, we are finding expected fluctuation in the collections spaces during the shutdown, with the system recovering to its set point a short time after being turned back on.

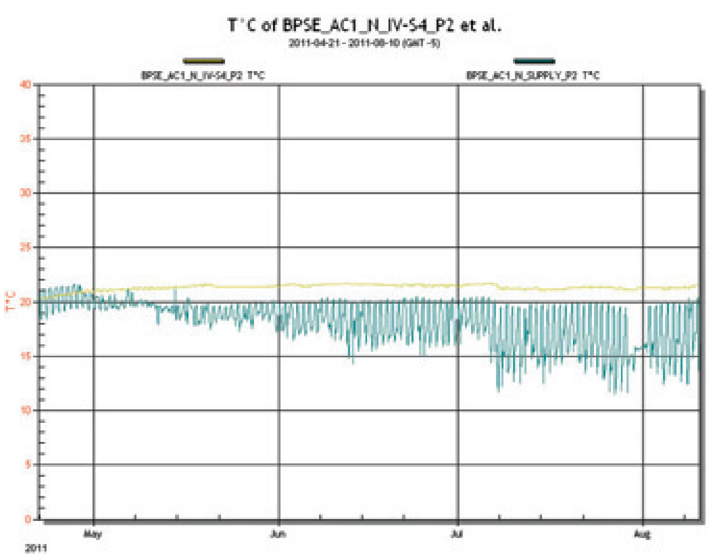


Fig 1. Temperature plots of supply air and space temperature in the BPSE Stacks at NYPL over a roughly five-month period. The plots show the fluctuation in supply air during the shutdown, while the space temperature remains stable.

Figure 1 shows a temperature graph for slightly less than four months of data from the Bryant Park Stack Extension at NYPL during the summer of 2011. Two datasets are shown. The green plot shows the condition of the supply air to the collections space during the period, while the yellow plot shows the recorded air temperature in °C from one recording location within that AHU's zone in the collections storage area. There are three primary pieces of information to take from the green plot – first, the fluctuation is representative of the shutdown schedule being in affect. Second, the green plot shows two types of seasonal operation in this system. During April and the first part of May the system is in heating mode, with supply air warmer when the unit is turned on, and cooler during the shutdown. After the first week of May through the rest of the plot, the system is in cooling mode - the supply air is cooler when the system is on, and warms up when the system is shut down. Third, the fact that the yellow plot shows less than 1°C in fluctuation during the nightly shutdown, with no cumulative gain in temperature over time, indicates the potential viability of the strategy in this space. With no cumulative increase in temperature, and little fluctuation during the shutdown itself, the off-period is having little to no impact on the preservation quality of the space, and energy is being saved during each shutdown period.

Figure 2 shows a temperature plot from a collections space in the Library Annex at Cornell University over a span of roughly six days. As mentioned previously, Cornell requested that we design the experiment at the Annex to run as two four-hour shutdowns per day, rather than one eight-hour period. The fluctuation in space temperature is slightly more pronounced than at NYPL (partially due to graph scale), and clearly shows the shutdown schedule. More significantly, the fluctuation is less than 1°C and the system is able to recover to its set point with no cumulative gain in space temperature. Again, energy savings is achieved during the off-period with little to no impact on the preservation quality of the environment.

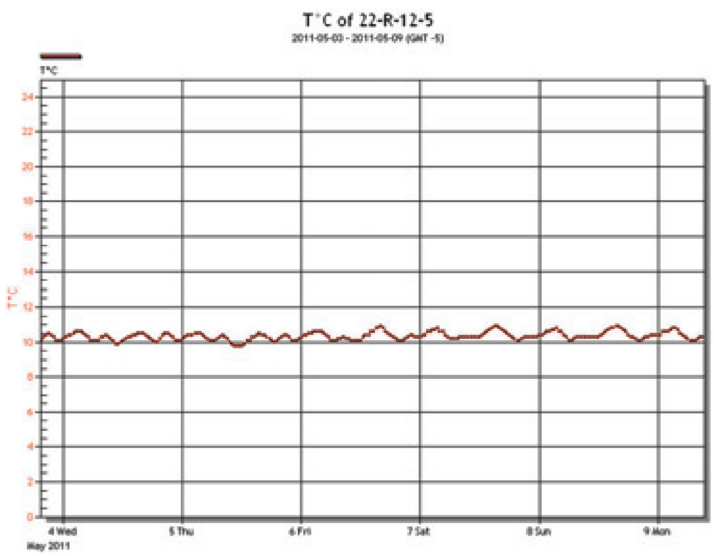


Fig. 2. Temperature plot of space temperature at the Library Annex at Cornell University. The plot shows fluctuation of roughly 1°C in the space during two separate four-hour shutdowns in a 24-hour period.

Relative humidity fluctuation in the spaces during the shutdown period is minimal, with fluctuations of 2% to 5% observed. Data collected to date indicates that the systems recover their set point, or at least return to the condition they were previously providing, when they turn back on. Due to the rate of moisture equilibration for most collections materials (up to 30 days to full equilibration), this small amount of relative humidity change in the air should have little effect on the overall preservation quality of the environment.

Potential Benefits

Carefully managed shutdowns of mechanical systems that serve collections storage areas have potential benefits for both preservation and energy savings. In locations with a seasonal cool or cold climate where the typical system operation is to add heat to the airstream in order to maintain set point, there is the possibility that shutdowns could lead to a decreased rate of chemical decay due to lower temperatures during the shutdown period. While such an effect over a four or eight-hour shutdown could be minimal, proof of concept could support cool/cold weather shutdowns of longer durations, provided relative humidity could be kept within reasonable bounds.

The potential for energy savings as a result of system shutdowns is both real and meaningful – shutting equipment off is about the best energy saving action you can take! For most systems the potential savings come primarily from three different areas – electrical consumption at fans or electric heating, chilled water consumption at a cooling coil, and steam or hot water at a heating coil. The amount of electrical savings related to energy used at supply or return fans is often nearly directly proportionate to the length of the shutdown. For example, if the daily shutdown of a system was eight hours, or 1/3 of the day, the electrical savings from fan operation would be around 33%. Different factors can influence the actual percentage – for example, electrical billing in the United States often includes a "demand" that is independent of the number of hours of energy used, and can result in savings slightly less than 33%, but still significant. Savings at cooling and heating coils varies with each system and location, depending on how the system was designed to operate, and how much each component runs during different seasons. Nonetheless, each hour the AHU is turned off is an hour's worth of energy that a particular component may not be using. Data collected within the AHU, and detailed information about billing and energy rates, will allow us to calculate energy savings for the systems we are working with at each partner institution.

Lessons Learned to Date

We have experienced some unexpected occurrences and variables that will influence how we approach conclusions regarding the final success of the methodology for this research. We expected, and it has proven true, that communication and cooperation between collections staff, facilities and administration is crucial to the success of the project. In one instance, a system that was to be part of the experiment was never placed on the final experimental shutdown schedule due to a simple miscommunication with the facilities operator in charge. While the mistake was caught, it wasn't until several months into the project, reducing the amount of data that we will have for that particular system.

A system shutdown seems like a relatively straightforward proposal until you begin working with the control systems that operate AHUs, and holding to the schedule can be harder than expected. We have seen systems fall off the schedule due to emergency maintenance, holiday shutdowns that reset all AHU controls to pre-experiment defaults, and equipment malfunction. Our experience shows that it is not enough to monitor the conditions within the space, the system itself has to be monitored regularly to ensure the desired operating schedule continues.

We knew from the onset that shutdowns would not be appropriate for every space, season, or climate. While we do not yet have a full set of data to analyze, it is likely that some spaces and systems may not be able to hold reasonable conditions during an eight-hour shutdown during hot, humid summer months, and that such operation, while beneficial in terms of energy savings, may prove unwise for collections preservation. Further experimentation may be needed to determine if there is any appropriate length of time – perhaps two to three hours instead of eight – for those locations.

The Goal

While it is too early to draw conclusions at this stage of the research, the methodology does provide a clear picture of what it takes to design an appropriate experiment and what it is likely to take to implement these practices in a practical manner in the future. One project goal – to determine whether monitored, risk-managed shutdowns can reduce energy consumption without negatively affecting the collections storage environment – supports a key component of IPI's research and education mission: enabling cultural institutions to define, achieve, and maintain an optimal collection storage environment. We define an optimal storage environment as one that achieves the best possible preservation of collections at the least possible consumption of energy, and is sustainable over time. Appropriately applied shutdown strategies have an important place in that equation, and determining their feasibility, and the methodology needed to practically apply them, will bring us closer to that mission.

Project Funding

We are grateful to the Institute of Museum & Library Services (IMLS) for providing funding for this project through their Research & Demonstration National Leadership Grant program.

Investigación sobre las oportunidades de ahorro energético en las bibliotecas

Las investigaciones han comprobado que las condiciones ambientales (temperatura y humedad relativa) son los factores más significativos que afectan la vida útil de los materiales culturales que albergan las instituciones. Por lo tanto, los sistemas mecánicos en los ambientes bibliotecarios con frecuencia están diseñados para funcionar de manera continua a fin de mantener las condiciones ambientales deseadas, lo cual por lo general resulta en un elevado costo tanto monetario como de consumo de energía. La alteración de estas condiciones mediante cambios en los horarios de funcionamiento de la calefacción, ventilación y aire acondicionado (HVAC, en inglés) es un riesgo que muchos bibliotecarios e instituciones no se atreven a correr. El Instituto de Permanencia de la Imagen (IPI) y los asesores en materia de energía de Herzog/Wheeler & Associates, emprendieron un proyecto de investigación de tres años en noviembre de 2009 para probar la hipótesis de que el uso de la energía en las bibliotecas y las instituciones culturales se puede reducir significativamente mediante el apagado, cuidadosamente monitoreado y con control de riesgos, de las unidades manejadoras de aire, durante las horas no ocupadas en espacios seleccionados, sin comprometer la calidad del ambiente de preservación.

Los participantes en el proyecto de investigación son la Sterling Memorial Library de la Universidad de Yale en Connecticut, la Southern Regional Library Facility y la Young Research Library de la Universidad de California en Los Angeles (UCLA), la Park Stack Extension de la New York Public Libray (NYPL) en la ciudad de Nueva York, el Library Annex en la Universidad de Cornell en Ithaca, NY, y los depósitos principales de la Birmingham Public Library en Birmingham, Alabama.

Además de la metodología y los resultados preliminares, este trabajo presenta las lecciones aprendidas hasta ahora durante el proceso de investigación, los hallazgos inesperados y el impacto potencial en el ahorro de costos de estas prácticas.

Understanding the Environment in an Archive Store

by Kostas Ntanos, Head of Conservation Research and Development, The National Archives, UK,
and **Sarah VanSnick,** Conservation Research Assistant, The National Archives, UK

Introduction

The National Archives (TNA) is the official archive for the England, Wales and the UK government. One of the main aims of TNA is to preserve and protect its 11 million records that date back over 1000 years.

TNA's collection is stored in 15 repositories in two connected buildings at its site in Kew, London. The three main repositories are in the building known as 'Q1', built in 1978 and 12 smaller ones are in the 1996 'Q2' building (Fig. 1). The larger Q1 repositories are open plan, with an area of approximately 6500m^2 each. The air-conditioning system serving Q1 includes four plant rooms in the basement of the building, with each plant room serving the quarter of the building positioned above it (Fig. 2). The conditioned air is delivered from vents located around the perimeter of the building with the air returns located in the centre (Fig. 3). This is a typical office layout for a heating, ventilating and air conditioning system (HVAC) and was designed with the intention that the air from the four plants mixes to provide a uniform environment as it moves towards the central return. The repositories in Q2 are approximately 700m^2 to 1000m^2 each, and are arranged over four floors. The air-conditioning system in Q2 has dedicated air handling units (AHU) for each repository. The two buildings have separate Building Management Systems (BMS).

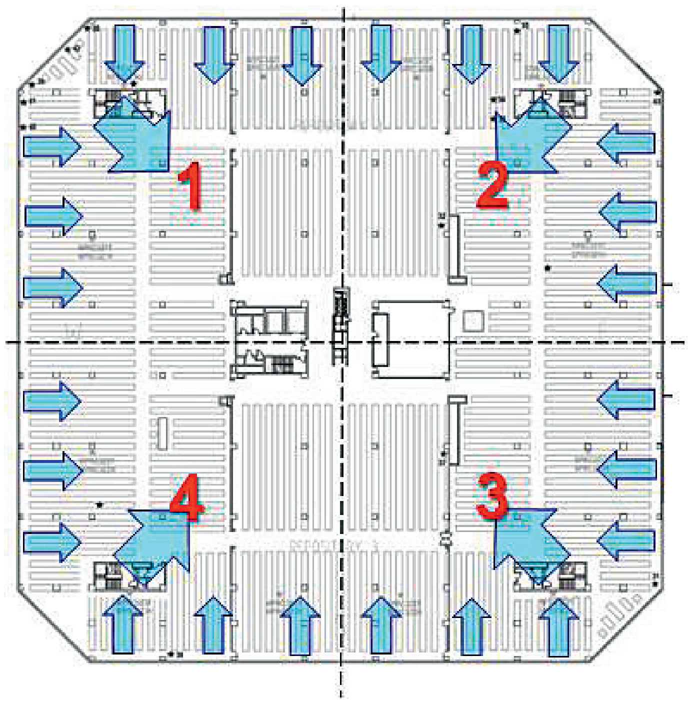
Both of these vast HVAC systems are complicated and costly to operate and maintain. Faced with this reality, along with the need for UK public bodies to meet government sustainability targets and a growing concern for greater environmental responsibility globally, it was imperative that the repository environments at TNA were better understood and managed. Presented here are summaries of the diverse evidence-gathering projects carried out over the last four years to inform decisions made in relation to TNA's repository buildings and environment.

Climate Mapping

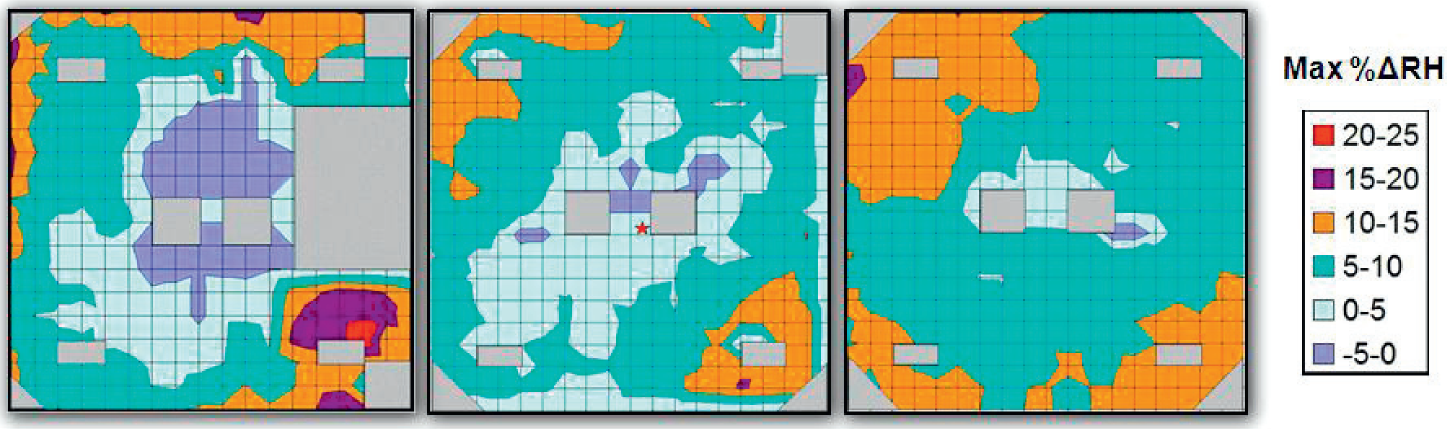
In 2007 the Collection Care Department initiated a climate mapping exercise [1] of all TNA repositories. These used a very tight grid of dataloggers to record environmental conditions across the different repository spaces. The results were presented as two-dimensional plans of the repository floors and demonstrated that there was large variation in environmental conditions in the Q1 repositories that were not being recorded or identified by the environmental monitoring at the time, which relied exclusively on the Building Management System (Fig. 4). While the environment in the smaller, newer Q2 repositories was consistent across the space, microclimates were being created in areas of the large open planned repositories in Q1.

1. Main entrance of The National Archives with the Q1 building on the left and the Q2 building on the right.

2. Section of the Q1 building identifying the location of the plant rooms (highlighted in blue) and the repositories (highlighted in orange).



3. Plan of a repository floor in the Q1 building illustrating delivery of conditioned air from the HVAC system along the perimeter of the building and its movement towards the centre.



4. Climate maps of Q1 repository floors 2, 3 and 4 showing the percentage difference in RH across each floor.

Environmental Monitoring System

Evidence provided by the climate mapping exercise was integral to making a successful case for the funding and the development of a new environmental monitoring system in 2008. A wireless radio-telemetry system by Hanwell Instruments Ltd. was installed to monitor temperature and RH with the layout of sensors informed by the results of the climate mapping. The system comprises 127 sensors distributed across the three repositories of Q1 (Fig. 5) and 12 sensors in Q2, one in each repository. Additionally, there is an external sensor on the roof of the Q2 building. The sensors record conditions every 15 minutes. This facilitates real-time monitoring by staff in several departments but also creates over 12 million individual data points of environmental information every year.

Annual Environmental Assessment

To interpret and interrogate the data produced by the Hanwell system, a comprehensive environmental assessment report (AEA) is carried out annually [2]. This report is a retrospective evaluation of the storage environment, with the aim of delivering a comparative and accessible annual record of the conditions in the repositories.

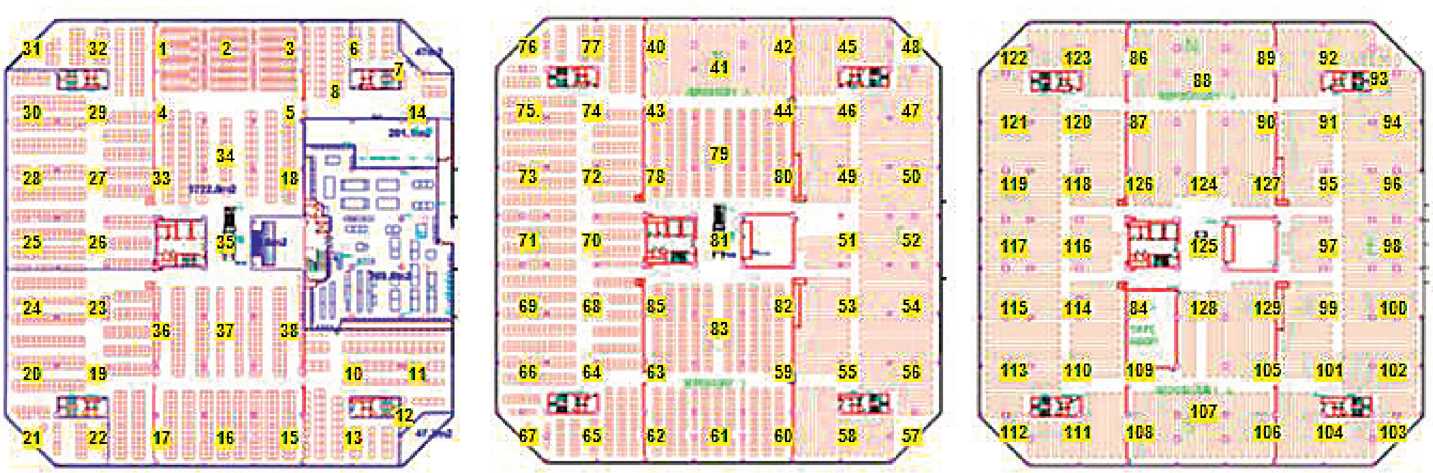
The data is presented as monthly two dimensional colour coded floor maps of the repositories in Q1 and can be animated in an annual sequence. Repositories in Q2 do not require spatial graphs because the environment is consistent across the space.

Data from each sensor is exported monthly manipulated to clean any interference data and saved. A series of Excel spreadsheets has been developed with functions that automatically draw in the relevant data and generate the monthly maps and graphs.

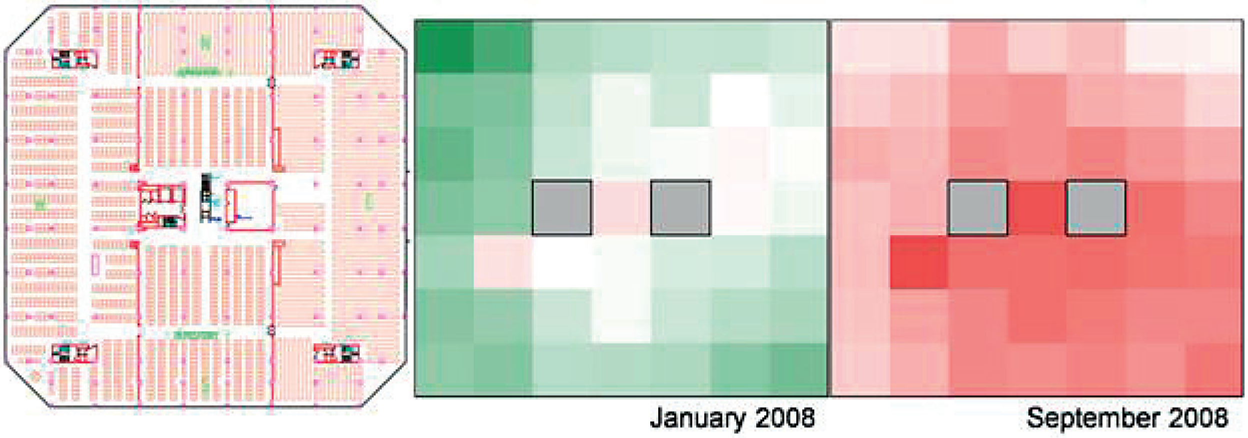
The AEA is a departure from evaluating environmental performance based on a narrow range of environmental conditions as a success measure. Instead it is an evaluation based on the assessment of a range of interdependent factors that impact on the preservation of the collection. These factors are: chemical degradation, environmental stability, the probability of mould growth and the impact of the external environment on the conditions achieved inside the repositories.

Chemical degradation

Isoperms[3], which provide a way to quantify the combined preservation effects of both RH and temperature, were used to assess chemical degradation of the collection. Annually, relative permanence in Q1 follows the external seasonal variation, peaking high in the winter months and dipping lower during the summer (Fig. 6). Mapping illustrates that relative permanence is generally higher on the perimeter of the Q1 repositories due to the location of the HVAC air supply ducts, which delivers air at low temperature. This situation can result in elevated RH in some areas of the perimeter. As isoperms are weighted towards



5. Hanwell RH and Temperature sensor layout across Q1 repositories 2, 3 and 4.



6. Example of permanence maps for 3rd Floor Q1. White shows the permanence value achieved by the HVAC set points, while higher values become greener and lower values more red.

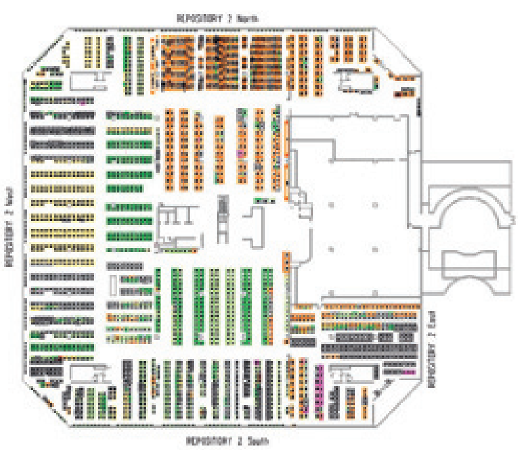
temperature, the chemical degradation maps must be examined in conjunction with the rest of the AEA before conclusions can be drawn. The HVAC system serving Q2 is more powerful, hence seems to be less affected by external conditions.

Environmental stability

In order to provide a measure of environmental stability, skewness [4], a statistical measure of the degree of asymmetry of a distribution was employed. When the HVAC system is working successfully, the data should be clustered tightly around the set points, resulting in a low skewness.

The results for skewness demonstrate that there is a significant difference in the stability provided by the four plants serving Q1 (Fig. 7). For most of the time negative skew in RH mirrors positive skew in temperature and vice versa. However there are instances when both RH and temperature have the same skewness, which indicates either a mechanical fault in the system or the effect of exogenous factors.

In Q2, the RH generally seems to be following the external seasonal change in dew point, with the corresponding temperature shift. Contrary to what would be expected, the warm summer months of July and August show very small skew. It is clear that the HVAC system in Q2 copes with external high temperatures whereas in Q1 the internal temperature follows the external seasonal variation to a greater extent.



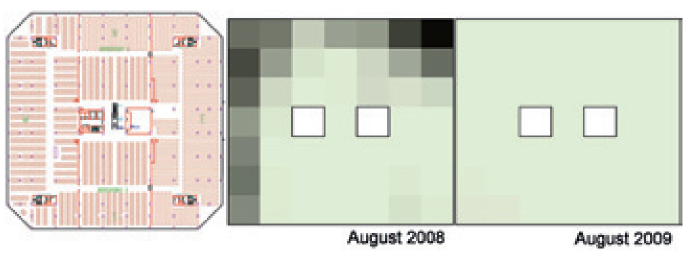
7. Examples of skewness maps of the 3rd Floor Q1 showing differences in the operation of the four HVAC plants.

Mould Growth Hazard Index

The Mould Growth Hazard Index (MGHI) indicates the likelihood of mould growth in the repositories. The MGHI is based on the number of days to mould germination as a function of the combination of RH and temperature according to mould germination isopleths at 20°C [5]. Each combination of RH and temperature, providing that RH is above 65%, is assigned a value that rises exponentially and is proportional to the time spent under that combination of conditions. The total MHGI of each monitoring point is the sum of all values for all RH and temperature combinations recorded by that sensor over a month. While accurately predicting mould growth is far more complex and involves additional factors beyond environmental conditions alone, the MGHI does illustrate those areas most at risk.

The first AEA in 2008 demonstrated that the MGHI is zero for most of the year, but increases for the months of July, August and September in Q1 while Q2 repositories show a consistently zero MGHI. As expected, the MGHI is higher around the perimeters of the Q1 repositories due to the high RH resulting from the cold air supplied directly from the HVAC system in those areas.

Since the first assessment in 2008, there has been a significant reduction in MGHI in Q1 repositories. In 2009, based on the information provided by the 2008 AEA, a decision was made to adjust the operational temperature set point of the HVAC system during the summer months. Raising the temperature set point by 2°C over the months of high mould risk enabled the reduction in RH for areas of concern. The 2009 MGHI maps showed no likelihood of mould growth in the repositories (Fig. 8).



8. MGHI maps of 3rd Floor Q1 for August 2008 and 2009. A comparison shows the reduced risk of mould in 2009. The darker colours correspond to higher MGHI.

Impact of external environment

This section of the AEA correlates TNA's monthly environmental Key Performance Indicators (KPI) to the external dew point (DP), highlighting the capacity of the HVAC system and any shortfalls in the system's operation and management. Examining this factor enables the management of expectations in relation to what the system can achieve throughout the year. TNA's monthly KPIs monitor the level of success in providing appropriate environmental conditions in the repositories. The KPI is calculated based on the percentage of time conditions were outside the required RH and temperature ranges in 21 different zones across Q1(13) and Q2(9). A zone fails if conditions were outside the specified limits for more than 10% of the time during a month. If more than 10% of zones in Q1 or Q2 fail in a month, then the KPI for that building is failed. DP was chosen as it encompasses both RH and temperature and it is the term HVAC engineers are familiar with in relation to the capacity of a system to condition fresh air.

The external DP follows an annual cycle of low levels in the winter months gradually rising in the summer to peak around August. In 2008 TNA's KPI failed for the months of July, August, September and October in Q1. This suggested that when external DP is above 10°C, the Q1 HVAC system cannot dehumidify the incoming air enough to achieve the required environment. However, it is unusual for October to fail the KPI due to high levels of RH, especially considering that DP was on average around 7.5°C. Therefore the failure in October is more likely to be due to shortfalls in the operation and maintenance of the system. Based on this information, in 2009 the KPIs were achieved every month because during the months with high DP the temperature set point of the HVAC system in Q1 was adjusted to accommodate the limitations in dehumidification (Fig. 9).

The AEA has enabled collection care staff to make the results of environmental monitoring more accessible to those both making the decisions and those maintaining environmental systems. It is important to stress that these four sections of the report must be interpreted as a whole in order to draw useful conclusions from the assessment. It is an invaluable contribution to the understanding of the collections' environment; providing critical evidence to inform TNA's strategic plans, preservation policy, and upgrades and maintenance to the building and its systems.

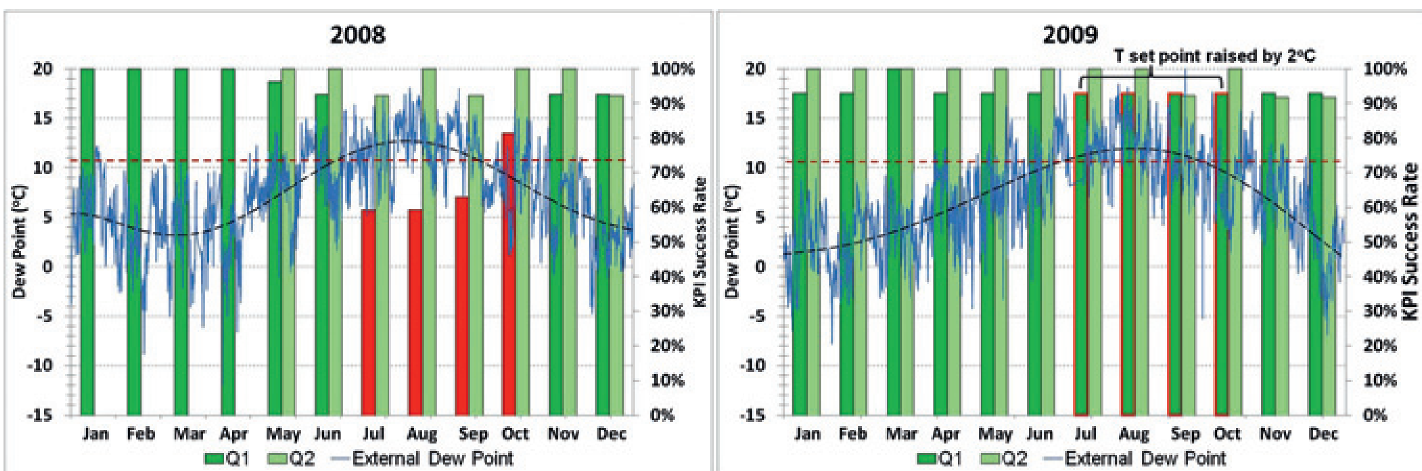
Building Environment Simulation

Environmental monitoring data also provided the cornerstone in the development of 'Building Environment Simulation' [6], a 22-month collaborative project with the Centre for Sustainable Heritage, University College London (UCL). The aim of the project was to examine different options in maintaining a sustainable and appropriate preservation environment for the collection, whilst at the same time achieving energy savings to meet the government target of a 30% reduction by 2015. The outcomes of the project would inform ongoing capital investment in the estate and enable TNA to build resilience for the future.

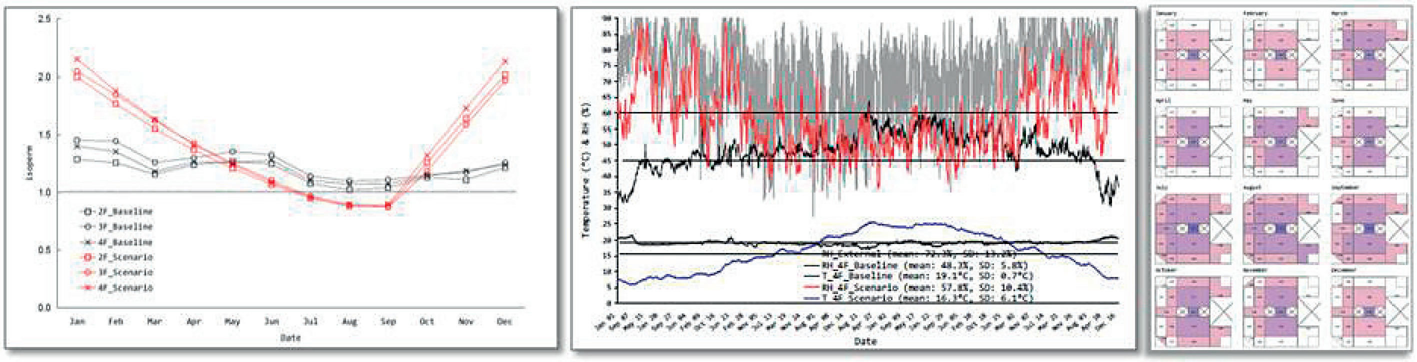
The project required the creation of a computer simulation model of the three repositories in the Q1 building. While UCL had extensive experience in the use of computer simulations to model building environments, they had never before applied it to the scale of the Q1 building or the context of an archival storage unit.

The computer simulation model was created using the software *EnergyPlus* [7], which is a trademark of the US Department of Energy and available for download from the internet free of charge. It is however a complex and sophisticated model that requires technical expertise for the construction and operation of the simulations. The model simulates RH and temperature inside a given space by taking account of all variables that contribute to, and influence the indoor environment. Crucially, for the project, the software also has the ability to simulate the energy load required to achieve a given environment through mechanical means such as an HVAC system.

In addition to the standard considerations impacting the RH and temperature within an indoor environment (building envelope, the outdoor environment, the operation of the HVAC system, people and the internal load (lighting)), the computer simulation model had to incorporate the effect that the vast amounts of hygroscopic material housed within the archive would have on the internal environment. UCL had already developed an additional module for the *Energy Plus* software that calculates and simulates the moisture and heat transfer between paper and its surrounding environment, which was used in the model.



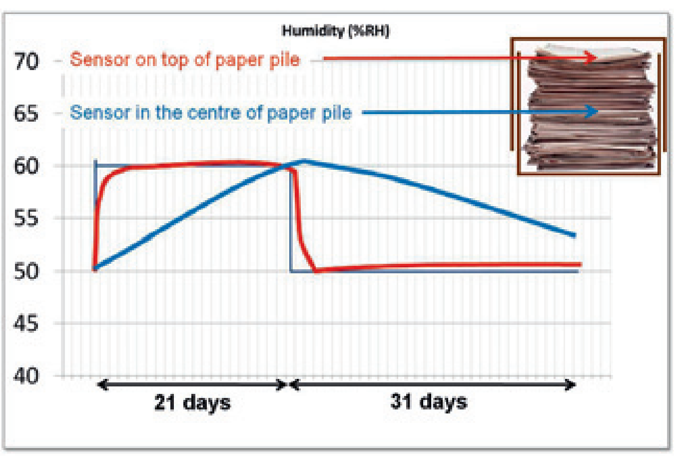
9. Comparison of the impact of the external environment between 2008 and 2009 due to adjustment of the temperature set point of the HVAC system.



10. Examples of results graphs from the Building Environment Simulation project.

Once constructed and validated, the model was used to examine several what-if scenarios including changes to the building, changes to outdoor climate, occupancy, content and operation of the HVAC system. The outputs of the model were analysed with a view to optimise environmental management and meet energy usage and carbon dioxide reduction targets, whilst providing appropriate preservation environment in storage. The model produces results as temperature and relative humidity data and TNA additionally requested the scenario results be presented as relative permanence maps of the repositories in order to compare the simulation outcomes to the AEA (Fig. 10).

The main outcomes of the scenario testing indicated savings in energy load between 20% and 40%. While powering down the HVAC system offers savings of up to 22% without afecting the preservation environment, the highest savings, 43%, was achieved by seasonally cycling the set pointfor relative humidity and temperature in the HVAC system. This scenario offered the benefit of improvement in the quality of the preservation environment in storage. The computer simulation also determined that under certain conditions the Q1 building can maintain the preservation environment without the use of the HVAC systems during the months of April, May and December. Finally, some scenarios dispelled longstanding beliefs, for example that additional roof insulation or blocking windows would improve the preservation environment in storage.
The data gathered during the project would only have otherwise been obtainable through a series of trial and error changes to the building and its systems that could have increased the risk to the collection.



11. Graph depicting the results of the initial investigation into the buffering capacity of archival boxes.

The Buffering Capacity of Boxes

At a smaller scale, the investigation into the interaction between the records and their surrounding environment continues with experiments exploring the capacity of archival boxes, in which the collection is stored, to buffer against changes in space conditions. Environmental monitoring data loggers were placed in the middle of a pile of paper records and also on top of the pile inside typical archival boxes with the same ratio of internal volume of the box to mass of paper inside the box. The boxes were subjected to changes of ambient relative humidity inside an environmental chamber and the response inside the boxes was recorded over time. Initial results show up to a three week time lag for a 10% ambient relative humidity increase to occur inside the centre of a full archival box (Fig. 11). As expected, even longer period is required for the same decrease to occur. The sensors on the top of the pile recorded a time lag of 2-3 hours, indicating that moderate changes of ambient RH that occur within this time period are not experienced by the paper inside the boxes in their full magnitude, if at all.

Collection Mapping

Finally, to complete the picture and improve storage conditions for vulnerable material, further evidence on the physical makeup of the archive was required. The aim of creating a map of the archive by material type was to locate vulnerable material types with a view to moving them to repositories where storage conditions can be more easily adjusted to their requirements. Building management software was used in order to present the data in a usable, visual format. Data from TNA's catalogue, collection surveys and CAD drawings were combined, resulting in each storage bay in the repositories being colour-coded according to the type of material stored there[8]. The resulting maps illustrate what materials are present in TNA's collection and how they are distributed in the repositories, providing for the first time a visual representation of the collection by material type in storage (Fig. 12).

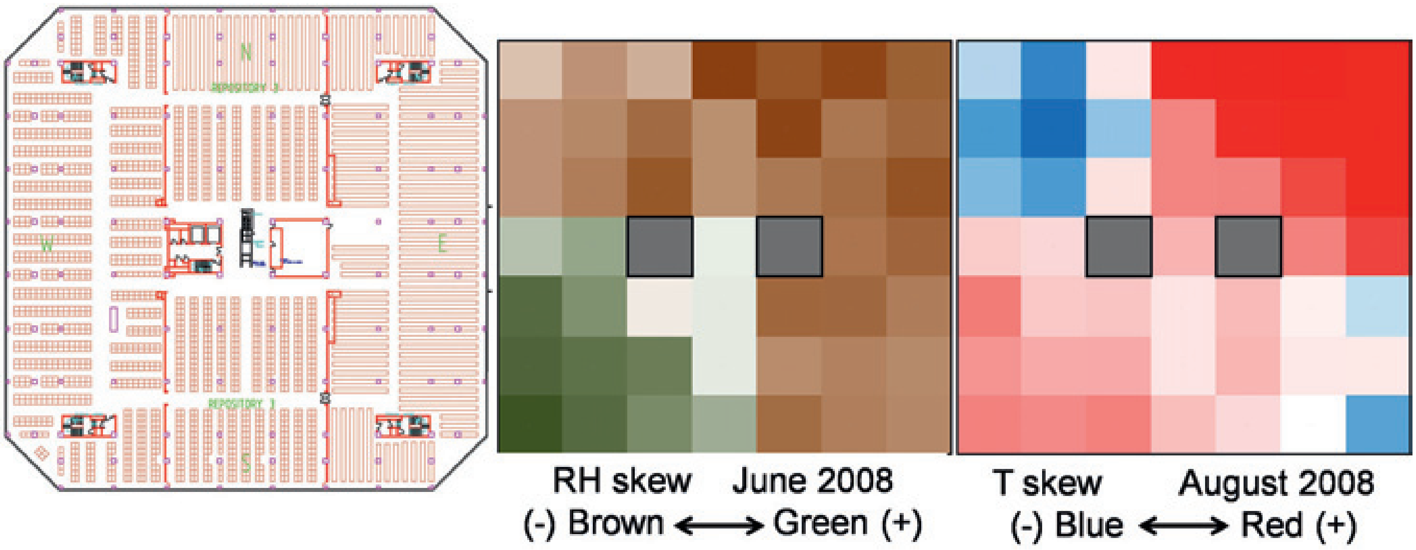
Moving Forward

The first practical outcome of the increasing understanding of the collection and its environment is the creation of a dedicated repository for all photographic and film material with temperature and RH conditions more favourable for their long-term preservation than the general conditions for paper based material in the main repositories.

TNA is currently progressing the implementation of the Building Environment Simulation project outcomes. Members of the Collection Care team are working with colleagues from Estates and Facilities to deliver a new operational strategy and schedule for the HVAC system including the ability to seasonally vary the set point. This has proven a more difficult task than first envisaged due to the need to upgrade environmental control software and controls in Q1 to enable the HVAC system to provide a variable set point.

Conclusion

All of the projects discussed here have proven invaluable in informing strategic and management decisions, improving conditions in storage, managing the HVAC systems and planning for reduction of energy consumption. These projects have also forged a stronger and closer working relationship between staff responsible for the care of the collections and those who manage the estates and facilities. A co-operative effort across both departments has proven essential; without it, the success of these projects would have been limited and the scope for implementation of the outcomes reduced. By building a better understanding of TNA's archive buildings, systems and the resulting indoor environments it has been demonstrated that a sustainable future for the site is possible without comprising the preservation environment provided for the records.



12. Plan of Q1 repository 2 with storage bays coloured according to the physical material located there.

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The National Archives Conservation Building at Pierrefitte-sur-Seine and its Air Treatment System

by Bruno Bonandrini, Heating Engineer, National Archives of France

The National Archives, a Democratic Institution Serving our Collective Memory

A democratic institution preserving France's memory, the National Archives are at a critical period in their history with the opening of a new building at Pierrefitte-sur-Seine, in the Seine-Saint-Denis department.
Created during the French Revolution, the National Archives conserve documents from the different political regimes that have followed one another from the 7th century to the present, as well as private archives and the records of Parisian notaries. The practice of State secrets that prevailed under the Ancien Régime gave way in 1794 to openness and communication of State archives, basic principles for all democratic regimes.

The Pierrefitte-sur-Seine Project

For many years, the National Archive's sites in the Ile-de-France region have been facing major difficulties related to their saturation and/or the difficulty in accessing them, which has raised concerns in the national and international community of researchers and archivists. The decision was therefore taken by the government in 2004 to build a new building for the National Archives at Pierrefitte-sur-Seine.

The project proposed by the architect Massimiliano Fuksas was accepted in May 2005 for the construction of this building whose final project brief was approved in the autumn of 2007; the building permit was issued on 18 June 2008 and the construction contract was notified on 19 May 2009. The building is scheduled to be delivered at the beginning of 2012.

The building designed by Massimiliano Fuksas is in keeping with the programme based on the principles of density, materiality and thermal inertia.

1. Pierrefitte-sur-Seine Site.

Characteristics of the Programme

Estimate of the staff
± 320 people

Detailed surface areas
Reading room: approximately 1,400m² (variable depending on the position of the separation between the inventory room and the originals room)
Capacity in the originals room: 160 seats
Inventory room: approximately 512m², capacity: 84 seats
Microfilm room: 338m², capacity: 50 seats
Foyer: 363m²
Temporary exhibition room: 400m²
Conference room: 280 seats

Usable surface area of the facilities
62,048m², including 44,000m² of conservation storage space (75%)
Total linear archiving capacity: 320kml

Land
Surface area: 43,960m² or 4.39 hectares

High-rise building
Building with ground+10 floors on an underground service gallery
Dimensions: 47.40m wide, 162.80m long and 38.58m high

SAT buildings
6 Satellite buildings: buildings between ground floor and g+5 on an underground level (car park)
Main functions of the SATs:
SAT A: reception / exhibit room / educational workshops and school groups
SAT B: conference room / foyer
SAT C: mainly offices
SAT D: unloading platform
SAT E: restoration workshop /gilding workshop / preventive conservation
SAT F: treatment rooms

Total surface area
Gross floor area: 108,136m²
Net floor area: 82,505m²
Usable surface area: 62,048m²

A Building with Strong Inertia Reducing the Use of Air Conditioning Systems

At the very start of programming for the National Archives centre at Pierrefitte-sur-Seine, special attention was given to the sustainable development question. Emphasis was placed on designing a building with strong thermal inertia in order to reduce the use of technical air treatment systems to ensure

environmental stability, with little use of the cooling capacity installed. The programme thus planned ahead for the RT2005 thermal regulations[1] applicable since 1 September 2006, making reduced use of air conditioning a key goal.
The conservation storage building, made of concrete with outside insulation, meets these needs. The satellites, which house most of the office functions, are equipped with a triple solar protection system (glazing with a very weak solar factor, shade screens built into the façade and outside shutters) and vents.
The conservation building's performances place it in the group of the least energy-intensive conservation buildings.

Conservation Building

The conservation building is a parallelepiped measuring approximately 160m long, 50m wide and 40m high.
Its base has a 2,500m² reading room, some offices and some technical rooms. The rest of the block is dedicated to document conservation.
The building comprises concrete walls that are 20 to 30cm thick, providing good thermal inertia and insulation from the outside with a 10-cm layer of rock wool.
The 220 storage rooms, each unit measuring 200m², make up 43,062m² of usable space for an average height of 3.3m.
There are no glazed openings to the outside except in the circulation areas.

Consequences of Thermal Inertia in the Storage Rooms

The goal of using less air conditioning has given rise to a compact building with a large concrete mass and external insulation.

On average, each storage room has 330 metric tonnes of concrete between the 30-cm thick load-bearing walls, 20-cm thick non-load-bearing walls and 40-cm thick pre-stressed concrete floors.

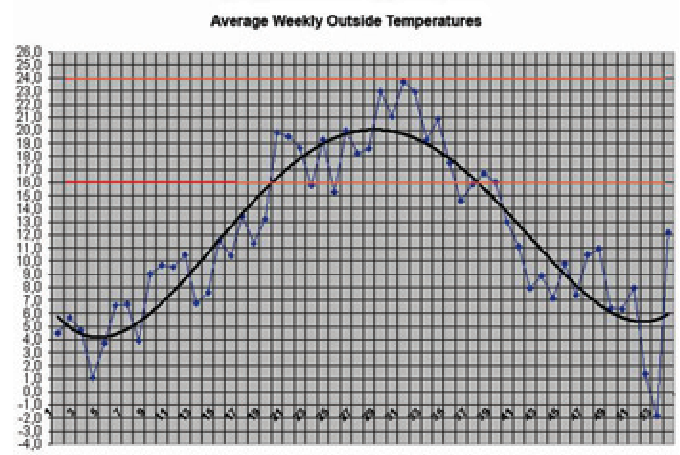
This leads to thermal inertia that can be calculated using the concrete's heat capacity of 880 joules per degree. 73kWh of heat has to be supplied for the temperature of a 330-metric tonne storage room to rise by one degree.

Given the thermal insulation installed on the walls and flat roof, heat losses for all 220 storage rooms amount to approximately 7kW for a one degree difference in temperature between the inside and outside of the building.

Using these elements, we can evaluate very concretely the consequences of thermal inertia:

- In summer: for an outside temperature of 32°C and an inside balance in the storage rooms of 22°C, i.e. a 10°C difference, without air conditioning, it will take 10 days for the building to reach 23°C.
- In winter: for an outside temperature of - 4°C and a temperature of 16°C in the storage rooms, i.e. a 20°C difference, it will take 5 days without heating for the building to lose 1°C.

This thermal inertia provides a buffer against variations in the outside temperature, between day and night, but also over the longer term on the scale of one week.



The observation of average weekly temperatures shows that the annual maxima are around 23 to 24°C, excluding exceptional episodes.

The need for air conditioning, excluding humidity treatment and compensation for possible internal contributions, can therefore be sharply reduced if we accept that the inside conditions are close to the 23/24°C zone.

In winter, on the other hand, the same approach cannot be used and only an underground building could go without heating, excluding air renewal.

Climatic Conditions for Conservation at the Pierrefitte Site

The desire to seek out energy savings in the part of the building to be used for conservation led to discussions on the set points to be adopted for temperature and humidity.

The former recommendations from the Direction des Archives de France (DAF) were 18°C +/- 1°C and 55% RH +/- 5%.

If these strict conditions are complied with, they lead to high energy consumption.
Widening the ranges of acceptable values naturally leads to reductions in heating and air conditioning.

Setting up a working group with the operation's programmer, himself having a strong awareness of energy issues, and several curators, led to a change in the set points.
Excluding the photo storage rooms, the following new conditions and thresholds are considered acceptable:

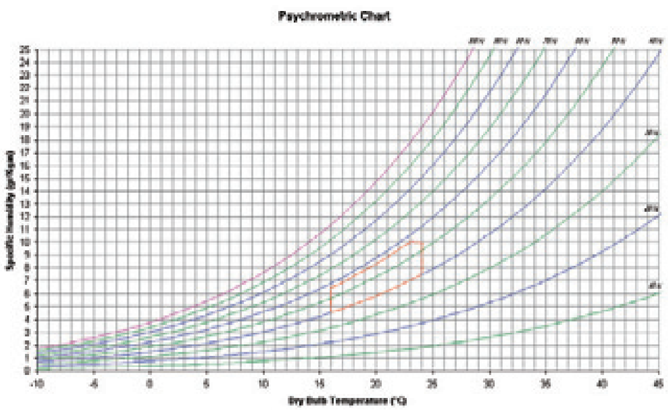
Temperature: [16 to 24°C]
Humidity: [40 to 57% RH]

1. The text of the RT2005 is available in French at: http://www.rt-batiment.fr/batiments-neufs/reglementation-thermique-2005/textes-de-reference.html (Accessed November 2011.)

Relative humidity close to 70% is highly favourable to mould growth. The 57% value chosen leaves room for possible contingencies affecting the controls.

The 24°C and 57% RH pair nonetheless remains a threshold zone and the decision was made not to go beyond 10g of water per kg of dry air, thinking here in terms of absolute humidity rather than relative humidity. Absolute humidity eliminates the notion of temperature linked to relative humidity.

The moist air psychrometric chart below graphically represents the desired zone for inside conservation conditions.



Strict requirements in terms of the speed of variation in inside conditions offset the new, wider range accepted for temperature and humidity.

Maximum temperature variations: 0.5°C per day and 2°C per week.

Maximum humidity variations: 1% per day and 5% per week. This is theoretical and nearly impossible to obtain, but we still consider it to be the target.
Below we will further discuss the methods implemented to reach this target.

The basic idea was that, except for values outside the thresholds, it is more important to ensure very small variations than the absolute values themselves. Repeated variations in temperature and humidity lead to the destruction of materials through modifications to their physical dimensions.

These small variations over time are considered to ensure good conservation, close to the natural conditions that have proven their effectiveness in some cases.

The lower temperature threshold value, 16°C, is not related to a notion of conservation, but rather to a demand for comfort for the personnel in charge of archive movements in the reading room. There are no workstations in the storage rooms, just an occasional short-term human presence.

Extending the set points for temperature and humidity will provide a 30% energy savings on heating and air conditioning. One-third of these savings are on temperatures and two-thirds are on humidity. These values are the result of an annual simulation with hour-by-hour calculations.

Ventilation Conditions

Ventilation includes two independent parameters:
- The rate of fresh air needed to ensure the renewal of inside air;
- The rate of air circulation, which firstly ensures the distribution of heating and air conditioning and secondly provides air movement so that no zones are deprived in terms of temperature and humidity.

Here again, the targeted energy savings have led to a large reduction in the volumes involved.

1. Fresh airflow rate: 0.1 volume/hour, full storage room

Equivalent to 0.07 V/h, empty storage room.
The usual DAF-recommended values are 0.3 to 0.5 V/h.
The value used at the BnF (Bibliothèque nationale de France) is also 0.3 V/h.

Reducing the fresh airflow rate by two-thirds is decisive for consumption and energy savings amount to 61% in cumulative values with the changes in the set points for temperature and humidity.

Fresh airflow under the former temperature and humidity conditions, with a renewal rate of 0.3 volumes per hour, is responsible for 70% of energy consumption. This becomes very important in relative values for a well-insulated building for which other sources of losses (walls and roofs) have been reduced.

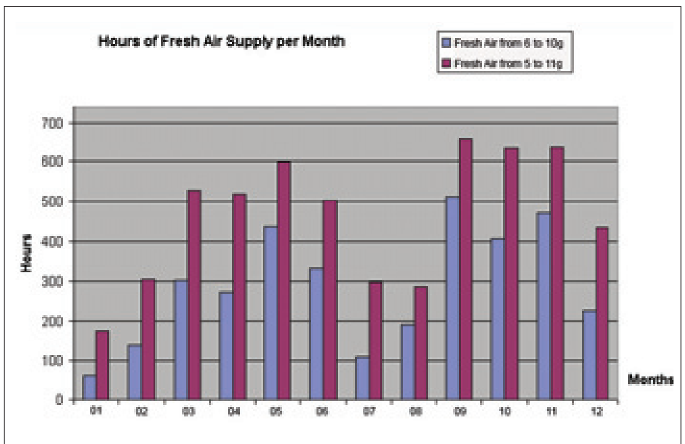
This is still a very important item in the heat balance, especially since humidity is controlled. Humidity is responsible for 44% of consumption related to fresh airflows.

The importance of consumption for fresh airflow gave rise to the following decision.

2. Total shutdown of the fresh airflow under unfavourable outside conditions

The fresh airflow supply is halted if the absolute humidity outside exceeds 11 grams of water per kg of dry air in the summer and if it is lower than 5 grams in the winter.

This avoids having to treat the fresh air under highly unfavourable outside conditions.



The previous graph (see p. 23) shows that the choice of the external conditions for shutting down the fresh airflow has serious consequences on the number of hours of ventilation.
For the coldest winter months (January and February) and for the hottest summer months (July and August), a variation of 1 gram of water per kg of dry air can lead to the doubling of the number of hours of fresh air supply. This 1-g value is the equivalent of 6 to 7% relative humidity.

The choice of 5g in winter and 11g in summer was made to avoid overly long consecutive periods without fresh airflow.

Furthermore, applying these strict conditions will nonetheless lead to a high rate of fresh airflow for the months of March, April, May, June, September, October and November for which there will be between 500 and 600 hours of fresh air per month. That is why the fresh airflow will be halted between 8 pm and 8 am during this period.

Application of all the restrictions leads to a selective fresh air intake for approximately 300 hours per month uniformly distributed throughout the year.

Additional savings on thermal energy are produced and the total reaches 70% compared with the initial conditions.

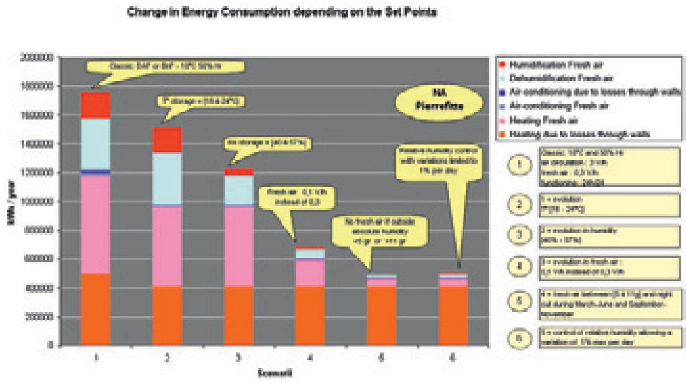
3. Rate of air circulation / ventilation

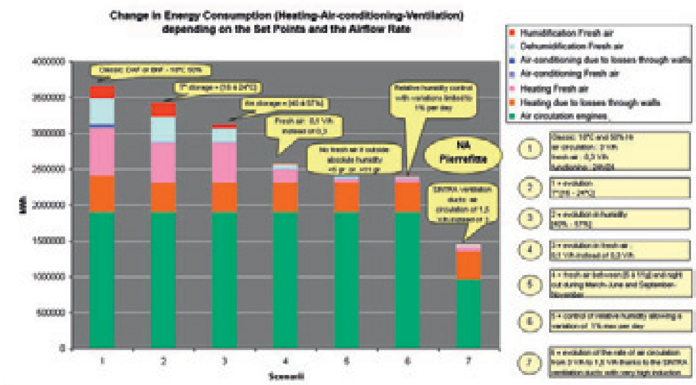
Rate of air circulation initially planned: 3 volumes/hour (usual value recommended by the DAF and also applied at the BnF).

Rate of air circulation adopted in the end: 1.5 volumes/hour (good circulation test carried out on scale 1 using an air distribution process with very high induction).

Special ventilation ducts are used to obtain the same desired air movement effect with half the usual flow rate.

This special air distribution process is sometimes used in the automobile and aeronautical industries when a high level of homogeneity in climatic conditions is desired for large volumes. The air supply duct has perforations calculated to obtain very high induction, ensuring that the ambient air moves with a lower blown airflow rate.





This point provides savings of approximately 50% on electricity consumption in the treatment units for air to be circulated.

These changes to the initial project are very important as this electricity consumption is equal to all thermal energy consumption for treating air for the storage rooms.

The two graphs above represent the changes in energy consumption per item, depending on the set points chosen. The first only concerns the thermal part and the second introduces electricity consumption for the circulation fans.

Complying With the Speeds of Variations in Temperature and Humidity

Temperature

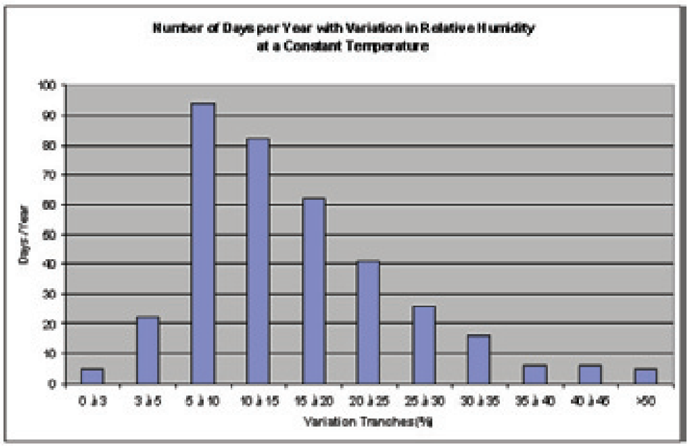
The stability target is 0.5°C per day and 2°C per week.
The building's inertia is such that its natural temperature variations are much lower than the target. We saw earlier that these variations will be approximately 1°C in 10 days for the summer period and 1°C in 5 for the coldest periods.
It would be enough not to disturb the building's natural tendencies with a poorly controlled fresh air intake.
It has never been hard to control a temperature to within a half a degree. All that needs to be done is to blow in fresh air at the ambient temperature of the storage rooms and the entire building will slowly shift in relation to the outside temperature.

Humidity

This aspect of the project is of utmost importance and is very difficult. The stability target is 1% relative humidity per day and 5% per week.

A study of the humidity conditions of outside air in the Paris region gives an idea of the problem.

If we want to continue to think in terms of relative humidity, we have to correct the outside air to a constant temperature in the calculations. The notions then become comparable to working with absolute humidity. Furthermore, this is what is done in practice: the temperature of the outside air is adjusted before being brought into the building.



The table above represents the number of days per year for which the variations in relative humidity are included in a given bracket.

For example, there are 94 days with a humidity difference between 5 and 10%. There are 82 days with a difference between 10 and 15%. There is not a single day with a difference less than or equal to 1%, which is our target. Variations in the humidity of outside air are therefore very strong and unrelated to our target.

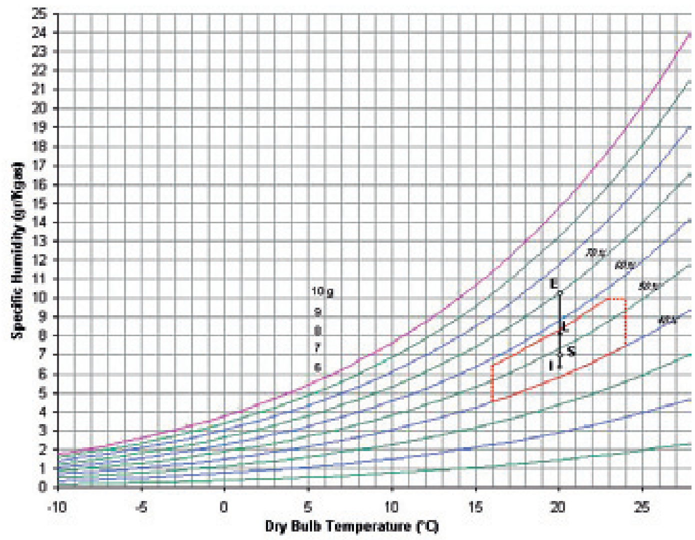
The air renewal rate of 0.1 Volume/hour means that all the air in the storage rooms is replaced with fresh air every 10 hours. We cannot count much on paper to dissipate variations in humidity. Tests have been carried out by the National Archives conservation department. They showed that a block of 20kg of archives, under real storage conditions, takes 4 months to go from 70% humidity to 50%. A "Bottin" (big French phone book) does not react to variations in humidity in the same way as a sheet of paper in a laboratory.

For our studies, we took the most unfavourable case and we considered that nothing would naturally compensate for variations in the humidity of the outside fresh airflow.

If we seek to achieve the target for the stability of humidity, fresh air must be treated with the greatest precision possible.

The following graph demonstrates the principle of humidity control.

In order to make it easier to understand these phenomena, the entire presentation is given for a constant temperature of 20°C inside the storage rooms, but also for the outside fresh airflow. Point "E" is representative of the outside air, i.e. 20°C and 70% RH, for the example.



Point "I" is the air inside the storage rooms: 20°C and a little more than 40% RH.

Point "L" is the upper admissible limit in the humidity range: still 20°C, but 57% humidity.
Point "L" is interesting because it is the point to be reached for energy consumption to be as low as possible, since it is the point closest to the outside air conditions. It is therefore the point that will need the least correction possible for fresh air: in our example, it is a question of dehumidification.

Point "S" represents the conditions for blowing in fresh air: 20°C and a little less than 50% on the moist air chart.
By mixing the inside air, "I", with the fresh air treated at "S", i.e. dehumidified, point "I" progressively shifts toward point "L".

The speed of variation of point "I" is conditioned by the [IS] difference. The greater the difference, the faster the speed of change to "I".
Point "S" is therefore a set point for adjusting the humidity of fresh air. It is a set point that constantly changes. This is not common in controls.

The [IS] difference must be controlled in order to control the speed of variation and to reach the target of 1% per day.
This difference, which is constant, sets a speed of variation.
The main difficulty in applying this theory, which is simple, lies in the [IS] difference, which must be very small: approximately 1% RH.

The precision of a humidity sensor is approximately 2% of relative humidity.

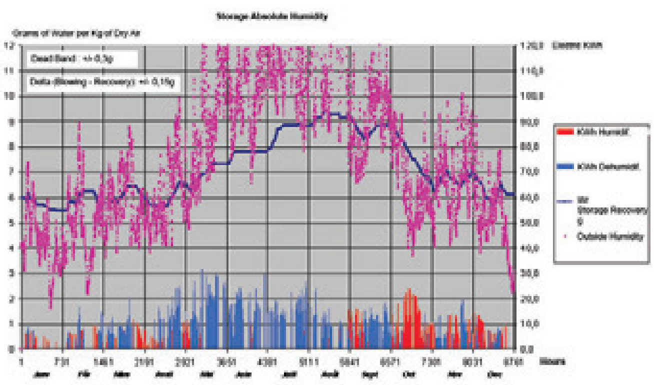
The simulations that we performed on the humidity control parameters for the fresh air blown in did not take this lack of precision into account and we cannot put a laboratory sensor in each storage room. We therefore do not know how this control will react or what level of precision will be achieved.

The graph p. 26 represents the hour-by-hour annual changes in the absolute humidity of the outside air and the absolute humidity of the air in the storage rooms obtained through theoretical simulations of the controls. We can clearly see the wide variations in the outside fresh air and the inside air, which tends to shift toward the outside conditions, while complying with the demands of the set points.

The main control parameters are:

- The dead band (+/- 0.3g on the graph): this is the stability of the control. It is what keeps us from excessively and pointlessly alternating between the two humidity control functions, humidification and dehumidification.
- Delta (Blowing – Recovery) +/- 0.15g: this is the [IS] difference that sets the speed of variation. The lower this value, the more the inside humidity curve is smoothed and the more it is stable. But energy consumption increases because the inside/outside difference is reduced slowly. In any case, we are limited by the precision of the sensors.

The choice of these parameters is the result of a compromise between energy consumption, the stability of the control and technical impossibilities due to the humidity sensors.
These parameters can, of course, be changed during operations in relation to the real behaviour of the equipment. The planned values today are indeed those indicated on the graph. Theoretically, they should make it possible to reach the target of 1% per day for 86% of the time, and for the remaining 14%, the variations in humidity will be approximately 2% per day.



We should not let the lack of precision in humidity sensors reduce our optimism because we are not so much interested in the absolute value measured by the sensor as in its stability, i.e. its resolution and its repeatability in comparisons. The measurement will be off but it may be very stable.
Another problem lies in the fact that the calculation for [IS] is the result of several humidity sensors that do not necessarily have the same measurement error or the same behaviour over time.

We will be able to observe these wonderful operating contingencies as soon as the building is commissioned, scheduled for the beginning of 2012.

If the realities in the field turn out to be unfavourable and the required precision of 0.15g absolute humidity is unstable or impossible to obtain, we are still far from having failed.

The goal is indeed to comply with a maximum variation of 1% over 24 hours. If we take our reasoning to the extreme, we can increase the 0.15g value up to a value that is compatible with the precision of the sensors (0.3g, for example) and obtain a change in humidity of 1% over 12 hours, then stop all fresh air intake, ensuring that the conditions reached are maintained. This may be brutal, but the goal is met in value, although not necessarily in its philosophy.

The idea should not be rejected; it is a first step toward chrono-proportional controls. When you cannot adjust power between zero and 100%, for example in certain cases of electric heating, you work with the equipment's operating time. The case of 12 hours on and 12 hours off is symbolic. In reality, this may mean one hour on and fifteen minutes off depending on the parameters adopted and the needs. Stopping the fresh air intake during shutdowns can be offset by a larger flow rate during periods of operation.

This is a layer of control that could be applied with the first one and will be explored if the situation in the field so requires.

Construction of an Archive Building in a Tropical Climate: the Saint Martin Media Library and Territorial Archives

by Anne Lebel, Director, Guadeloupe Departmental Archives, France,
with the collaboration of **Véronique Bigeard**, Architect

The French island of Saint Martin, with a surface area of 53km^2,[1] is situated in the north of the Lesser Antilles, 30km from Saint Barthélémy and 250km from the archipelago of Guadeloupe. In the past twenty years, its population has risen from 8 000 to 35 000 inhabitants. A former commune of Guadeloupe, on 15 July 2007 it became an overseas collectivity invested with the powers formerly held by the commune, department and region, together with some powers of the French State (taxation, highway maintenance, urban planning, maritime services, access to employment for foreigners, etc.). The French State representative is still the Prefect of Guadeloupe, assisted by the prefect's representative in Saint Martin.

This change in status has consequences for the management of the archives: the overseas collectivity of Saint Martin has taken over responsibility for the Departmental Archives, except for the scientific and technical supervision provided by the Guadeloupe Departmental Archives Department. Saint Martin – which must now put in place a proper territorial archive department whose duties will be the collection, classification, conservation, communication and development of this written heritage – has, since 2008, drawn up a planning schedule for the construction of a building to house the media library and Territorial Archives.

A site has already been chosen for the building: a large expanse of 2 246 m2 in the neighbourhood of Spring-Concordia, Marigot, which is home to public services (employment office, Social Security, hospital), educational establishments from nursery to high school, and residential blocks of flats to house a growing population. It is some distance from the sea, but is not entirely protected from major hazards.

Discussions with the Project Planning Engineer

The Guadeloupe Departmental Archives and the Direction des Archives de France joined the planning of the building from an early stage. The role of the Departmental Archives was not only to ensure compliance with the basic rules for the construction of archive buildings[2], but above all to adapt metropolitan French standards to suit a territory in a tropical location. My experience in French Guiana and Mayotte was a great help, as was the international French-speaking archivist portal[3].

I will therefore focus more specifically on the aspect of material conservation in a tropical climate.

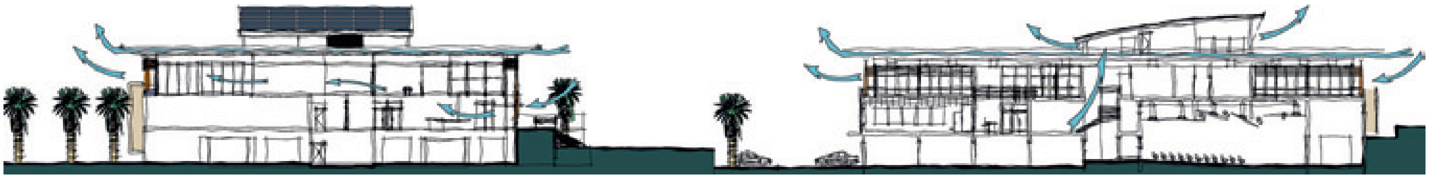
Before any approach to the future building, it was essential for it to be well sited in order to benefit from the prevailing trade winds and be protected from the sun and the rains. It would have been desirable for a complementary climate study to have been carried out alongside the project planning, but provision was not made for that. It was important not to lose sight of the fact that current studies and discussions within the French archivist community concerned temperate or more continental climates, but not tropical ones.

The 1990s and 2000s, which saw discussions on sustainable development, were marked by the concept of thermal inertia in archive buildings in temperate climates, putting an end to the near systematic use of air-conditioning in archive stores. The project planning engineer then suggested *'thermal inertia and [...] double skins instead of air-conditioning'*, showing that he was familiar with the conclusions of the Annecy conference in 2003[4]. The notion of the 'double skin' reminded me of the Governor of Mayotte's fine colonial building, built in the late 19th century, which had a fully integrated air-conditioning system: a building raised on piles, with a double skin and a chimney for expelling the warm air. The chosen principle was therefore a floor-level air inlet on the ground floor, the circulation of that air in the double partition, and its expulsion through the chimneys. All of this was able to cool a building but, in my view, was no substitute for the installation of air-conditioning in the stores, in view of the renewal and mixing of the air and the control of humidity in the long term. But, if there was a solution, I wasn't opposed to it. Yet I remained very sceptical.

A flat roof was the project planning engineer's preference, but it could pose a few problems linked to watertightness, as at the Guadeloupe Departmental Archives, where ongoing monitoring is required to prevent leaks from damaging the archives. The laying of an over-roof could solve this problem in countries where cyclones and tropical rainstorms further reduce watertightness, while also creating a cooling mechanism above the building.

The adaptation to the tropical climate also concerned the archive stores, for which I proposed raising the ceilings to a height

1. The island's total surface area is 86km^2: the Dutch part covers 33km^2.
2. Direction des Archives de France. Instruction DITN/RES/2009/013 of 10 October 2009. *Règles de base pour la construction et l'aménagement d'un bâtiment d'archives*, 3rd amendment, October 2009. http://www.archives-defrance.culture.gouv.fr/static/3281
3. The international French-speaking archivist portal (PIAF) offers training modules, including one on the construction of archive buildings in tropical countries, which was updated in 2009. http://www.piaf-archives.org/espace-formation/mod/resource/view.php?id=31
4. Journées internationales d'Annecy sur les bâtiments d'archives, 27 and 28 May 2003. http://www.archivesdefrance.culture.gouv.fr/gerer/batiments/colloques/. At the Annecy conference, Pascale Morel, an architect at the CNES, the French space agency, presented the CNES archive building in Kourou (French Guiana), stressing the constraints and solutions specific to tropical climates.



1. Natural ventilation by trade winds.

of over 2.5 metres. In Mayotte, I had recommended 2.8 metres in order to improve air circulation and, as in 19th-century colonial buildings with very high ceilings, allowing the warm air to rise in the event of the air-conditioning breaking down. To improve the expulsion of that warm air and provide better ventilation, high windows (above the shelving) were recommended. I wondered about the presence of hoods above these windows to prevent the harmful effects of the sun's rays on the archives. I stressed that high windows with hoods presented the additional advantage of protecting the archives from sunlight when at head height. This solution also offered a wider latitude for positioning the building, no longer according to the sun, but according to the trade winds, which are used to ventilate the stores in the event of the air-conditioning failing.

The plan to systematically install mobile shelving struck me as adventurous: this significantly reduced air circulation in the stores, even if basic rules required there to be a space free of archives at the top (approx. 15cm) and bottom (approx. 35cm between the top of the shelves and the ceiling). In the event of the air-conditioning system breaking down, these shelves would prevent the air from circulating freely, creating areas of condensation (at the same time as humidity soared). At the French Guiana Departmental Archives, a prolonged, repeated failure of its air-conditioning system in a store equipped with mobile shelving meant that bit by bit the archives turned into blocks of cellulose. With no guarantee of fail-safe logistics for maintaining an air-conditioning system running continually, I advised against this type of shelving in a tropical country.

The Architect's Proposals

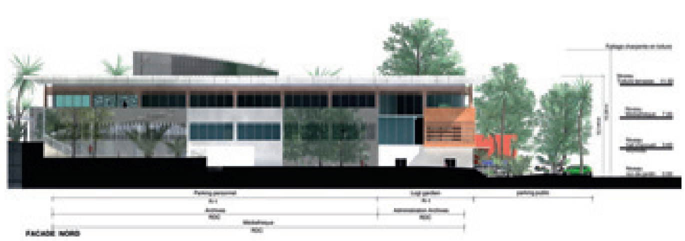
In 2009, the building construction project was entrusted to the architects Magma and Véronique Bigeard, associates of Pointe-à-Pitre (Guadeloupe). This choice was the culmination of discussions held with the project planning engineer, commissioned by the overseas collectivity of Saint Martin to present a planning schedule.

The project is, first and foremost, coherent and clear to the public, who on setting foot in the entrance hall are able to identify the three options offered to them: media library, auditorium and Territorial Archives. The Archive areas are grouped together on the ground floor and present coherent overall functioning, which could nevertheless be perfected. The media library, meanwhile, takes up the whole of the first floor. The two are able to function independently. Magma submitted a detailed study, including of the tropical climate, envisaging technical solutions to offer good conditions for the material conservation of the archives: air-conditioning, protection from sunlight and fire, and use of reinforced concrete.

The Territorial Archives are installed on the ground floor but, due to the natural slope of the terrain, that level is situated above a parking area, thus forming a 'buffer zone' between it and the floor of the Archives and therefore protecting against the risk of flooding. The Territorial Archives include three archive stores, offices and work spaces, and two rooms for receiving the public (an education service and a reading room), giving a total area of 1 000m^2.

The building covers an area of 52m x 39m. Its structure is of reinforced concrete. From the outset, the architects integrate the building with its site and climate elements: '*The site, in the prevailing wind, is well protected from the sea spray by the natural barrier of the surrounding hills, but its set-back position offers good natural ventilation all the same. A reinforced-concrete base ensures that the level of the Territorial Archives is perfectly insulated from the risk of rising damp, and ventilates this lower level. [...] The main north-facing aspect chosen for the archives is, all the same, combined with a structural outer double skin in composite resin panels to the West and aluminium netting to*

2. West side. View on the entrance hall and public area of the Territorial Archives.



3. North Side and Territorial Archives.

the North and East. This wall will have latticework surfaces in places, to cater for the need for natural light. It provides protection from sunlight on the vertical walls and from the rain on the exposed sides.'

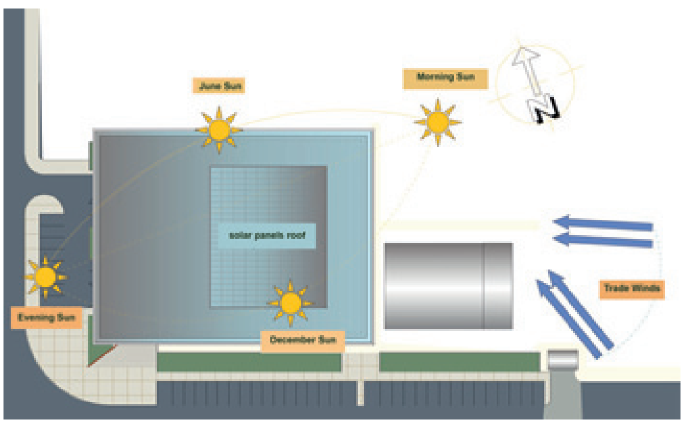
'A broad metal roof overhang shades and protects all the walls, complemented by an upper sunshade. The whole of this level is covered with a double metal covering, which provides an air space between the inside and the outer roof, itself made of sheet metal with waterproofing on a thick insulating layer, ensuring protection from sunlight with a slightly sloping roof.'[5]
The area set aside for the Territorial Archives benefits from a considerably small glazed area than the media library, thereby ensuring greater protection for the documents.

Environmental quality, at the heart of the architect's HQE[6] strategy, is based on a bioclimatic design which exploits both the trade winds and the sun. The roof overhangs which bring shade and protection against sea spray, the sunshades which protect the outer walls from the sun[7] and the sheathing of the sensitive walls bring protection against the harmful effects of the sun. A preliminary climate study made it possible to determine the positioning of the building: the trade winds are of a stable speed and direction, and there are approximately 2 600 hours of sunshine per year. The trade winds mean it will be possible to have a ventilated roof to cool the building, while at the same time protecting the flat roof from intense sunshine; the amount of sunshine means that electricity generation will be possible using photovoltaic cells.
The architect has adhered to the following main principles:
- Protecting the building from direct sunlight using roof overhangs combined with horizontal sunshades.
- Adapting the dimensions of the solar protection to the asymmetry of the sun's path[8], with *'the sun lower in the South at the winter solstice than in the North at the summer solstice'* (see fig. 5, p. 30).
- Protecting the inner walls from overheating caused by the sun, by adding a microporous double wall on the north and east sides enclosing the Territorial Archives, and a double wall of composite materials on the south and west sides.
- Improving natural ventilation through louvered windows which, when open, allow the trade winds to circulate throughout the building.

Finally, we did not opt exclusively for the 'double skin'. The architects suggested installing air-conditioning with a fail-safe mechanism: where the air-conditioning accidentally breaks down in one store, the neighbouring one will supply 50% of its own capacity. Thus, the spectre of total failure of the air-conditioning in the stores is banished. Since the building is small, the issue of whether or not to install a cooling system does not apply.

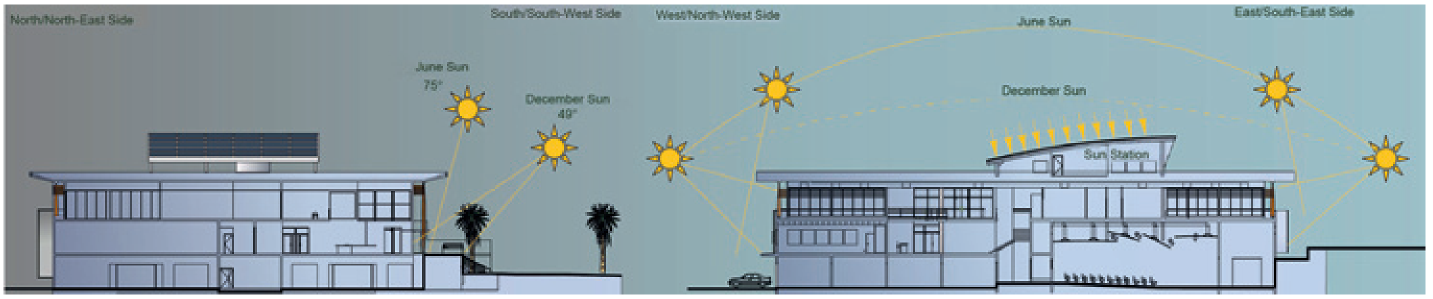
Each store is *'equipped with an independent system comprising an air-conditioning cabinet which enables the temperature and humidity to be precisely controlled'*. These cabinets are installed outside the stores to prevent any leakage onto the archives. The recommended average temperature in archive stores is higher than that recommended in countries with a temperate climate. It is set at 22°C + or – 1 to take into account the recommended temperature in the building (25°C) and prevent any thermal shock caused by a document passing from 18°C to 25°C when it is moved.

This contribution is merely an exchange of experiences and is certainly not intended to present all of the problems posed by the conservation of archives in a tropical setting. The future building of the Territorial Archives and Media Library of the Overseas Collectivity of Saint Martin offers real assurances that the island's archive heritage will be well preserved[9].



4. Daily path of the sun in December and trade winds direction.

5. Plan drawn up by architectural partners Magma and Véronique Bigeard.
6. The French 'High Environmental Quality' standard.
7. For the media library, the protection from sunlight is complemented by an outer gangway, which 'sets the glazed walls back from the plateau'. This architectural element is also found in the future building to house the Guadeloupe Departmental Archives.
8. The architect studied the sun's path and observed that for nine months it was in the South and for just over three months it was in the North. The sun's path is therefore not symmetrical according to the seasons.
9. I would like to thank Véronique Bigeard for agreeing to read through and comment on this text, and for providing the accompanying illustrations.



5. Annual sun path.

La construction d'un bâtiment d'archive en climat tropical : la médiathèque et les archives territoriales de Saint-Martin

L'île française de Saint-Martin est devenue depuis le 15 juillet 2007 une collectivité d'outre-mer et, à ce titre, a pris les compétences des Archives départementales. Saint-Martin doit désormais mettre en place un véritable service d'archives territoriales dont les missions seront la collecte, le classement, la conservation, la communication et la valorisation de ce patrimoine écrit. Pour ce faire, elle a engagé dès 2008 une programmation pour la construction d'un bâtiment dédié à la médiathèque et aux Archives territoriales, à laquelle ont été associées les Archives départementales de la Guadeloupe et la Direction des Archives de France.

Le rôle des Archives départementales ne fut pas seulement de veiller à ce que les règles de base pour la construction des bâtiments d'archives[1] soient respectées, mais surtout d'adapter les normes métropolitaines à un territoire situé en zone tropicale. Avant toute approche du futur bâtiment, il était indispensable de bien l'orienter afin de le faire bénéficier des alizés (vents dominants) et de le protéger du soleil et des pluies.

En 2009, le projet de construction du bâtiment a été confié aux architectes Magma et Véronique Bigeard associés de Pointe-à-Pitre (Guadeloupe). La qualité environnementale, au cœur de la démarche H.Q.E. de l'architecte, s'appuie sur une architecture bioclimatique qui exploite tant les alizés que le soleil. Les débords de la toiture qui apportent ombrage et protection contre les embruns, la protection solaire des parois extérieures par des brise-soleil et le doublage des façades sensibles permettent de se protéger des effets nocifs du soleil. Une étude climatique préalable a permis de définir le positionnement du bâtiment : les alizés sont stables en vitesse et secteur, et l'amplitude d'ensoleillement est d'environ 2600 heures par an. Les alizés ont ainsi permis d'envisager l'aménagement d'une toiture ventilée permettant de rafraîchir le bâtiment en protégeant le toit terrasse d'un ensoleillement intensif, et le soleil, d'envisager la production d'électricité par des cellules photovoltaïques. Toutefois, le choix exclusif de la « double peau » n'a pas été retenu et un système de climatisation sera installé avec la mise en place d'une sécurité : lors de l'arrêt accidentel de la climatisation dans un magasin, celui voisin fournira 50 % de sa propre capacité.

Le futur bâtiment des Archives territoriales et de la Médiathèque de la collectivité d'outre-mer de Saint-Martin offre ainsi de réelles garanties pour une bonne conservation du patrimoine archivistique de l'île.

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1. Direction des Archives de France. Instruction DITN/RES/2009/013 du 10 octobre 2009. *Règles de base pour la construction et l'aménagement d'un bâtiment d'archives*, 3e révision, octobre 2009. http://www.archivesdefrance.culture.gouv.fr/static/3281

With a Holistic Approach and Multidisciplinary Exchange towards Energy Efficiency in Historic Buildings Respecting their Heritage Value

by Alexandra Troi and **Roberto Lollini,** Institute for Renewable Energy – EURAC research, Italy, Coordinator of the European research project 3ENCULT – Efficient Energy for EU Cultural Heritage (FP7, GA n° 260162)

Abstract

The FP7-project 3ENCULT demonstrates that reducing the energy demand by Factor 4 to 10 is feasible also in historic buildings respecting their heritage value, if a multidisciplinary approach guarantees high-quality energy-efficiency solutions, targeted and adapted to the specific case. Twenty-two partners, including conservation, technical and urban development experts, industry partners and stakeholder associations, collaborate on the development of both methods and tools to support the holistic approach and multidisciplinary exchange and the needed technical solutions, both adapting existing retrofit solutions to the specific issues of historic buildings and developing new solutions and products. Eight case studies will demonstrate and verify the solutions.

"To include all the stakeholders in the design process of the energy retrofit of a historic building is a basic principle postulated by 3ENCULT…"

Introduction

Historic buildings are the trademark of numerous European cities, towns and villages: historic centres and quarters give uniqueness to our cities. They are thus a living symbol of Europe's rich cultural heritage and diversity. As these areas reflect the society's identity they are precious and need to be protected. Yet, this is also an area where the high level of energy inefficiency is contributing to a huge percentage of greenhouse gas emissions – mostly due to inefficient insulation, obsolete technological plants and inevitable replacing of original use. With climate change posing a real and urgent threat to humanity and its surroundings, also to historic buildings and surrounding infrastructure, it is necessary to act in this area and guide an improved approach to all refurbishment actions in historic buildings.

In numbers – more than 150 towns and urban fragments in Europe are declared to be World Cultural Heritage sites. If not only monuments of exceptional interest are considered but our historical urban areas in a more general sense, the significance of the built cultural heritage is even more emphasised: 14% of the European building stock dates before 1919, other 12% before 1945 – this implies that more than one fourth of our building stock does potentially characterise our "cityscape". These over 55 million dwellings across Europe with more than 120 million Europeans living in, are responsible for about 240Mt CO_2 emissions (only heating!) which correspond to 5% of 1990's EU-27-emissions [1].

Furthermore in times of rising energy prices, "fuel poverty" is an issue not to be under evaluated in numerous European cities. And finally, the comfort of users and "comfort" of heritage collections are also important factors to consider.

A reduction of Factor 4 to Factor 10 in energy demand is achievable, also in historic buildings, respecting their heritage value – if a multidisciplinary approach guarantees the implementation of high-quality energy-efficiency solutions, specifically targeted and adapted to the single case. This is the basic concept behind the project. 3ENCULT [2] will develop necessary solutions, both adapting existing solutions to the specific issues of historic buildings and developing new solutions and products.

A wide partnership involving all the stakeholders will allow a holistic approach considering all the aspects of the problems towards the definition of shared solutions. The project consortium includes all relevant players – either as direct partners or in local teams and the advisory board.

Multidisciplinary Team

To include all the stakeholders in the design process of the energy retrofit of a historic building is a basic principle postulated by 3ENCULT – an approach which is also reflected in the multidisciplinary project consortium itself.

Conservation experts represent the demand side for the preservation of cultural heritage. They define the specific needs of historic buildings and provide other partners with criteria for interventions. Within the conservation experts group, there are three partners contributing with special expertise on diagnosis and NDT-measurements.

Technical experts were chosen to cover all relevant energy efficiency issues. These include expertise on retrofit solutions for envelope and energy systems as well as answers to specific problems as e.g. moisture problems in beam, but also knowledge on potential damage mechanisms and integrated monitoring & control. Most of the technical partners do already have experience with interfacing cultural heritage issues. The research & development tasks were defined based on needs of the field - and not specifically of case studies, which however will provide valuable feedback on performance and applicability. On most of the R&D tasks are working tandems of research and SME/industry partners, covering the themes of (i) internal insulation, (ii) active solar solutions, (iii) ventilation, (iv) lighting and (v) windows.

Specialists for urban development transfer the developed solutions into the urban context. They prove the effect of the results on urban scale and elaborate concepts for the integration of solutions into masterplans and regulations.

Implementation and dissemination are brought forward on different levels by stakeholder associations but also with the production and distribution of Video News Releases and the interface with European regulations and standardisation.

Moreover, within so called **Local Case Study Teams** besides one project partner, who acts as focal point and scientific partner, there are gathered building owners, architects and engineers in charge of the retrofit works and representatives from the offices for the protection of historic monuments as well as from other local bodies concerned (e.g. city council).

Holistic Approach

The guiding principle in 3ENCULT is that for each energy retrofit of a historic building the multidisciplinary exchange between all the stakeholders starts with the comprehensive diagnosis of the status quo, supports the development of solutions and selection of the most appropriate one, and does not end before integrated monitoring and control are in operation, which verify and guarantee performance.

Comprehensive Diagnosis

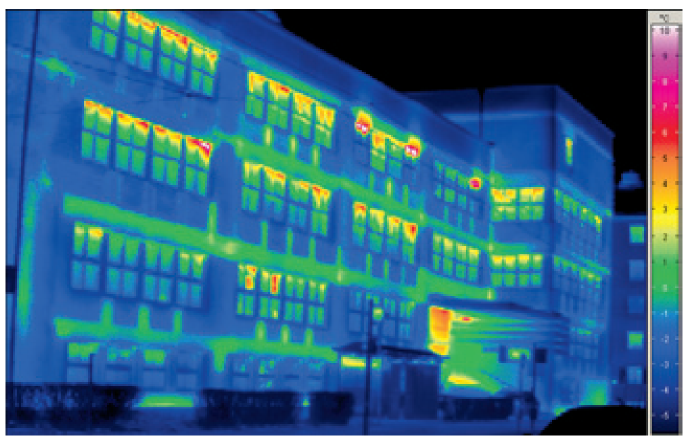
Prior to any retrofit intervention on a historic building has to stand a complete survey. This starts with the description of the history of the building and continues with the complete information acquisition on the substance especially with respect to the traditional historic materials and constructions. Methods to be applied include (i) conservation inventory system (as e.g. "Raumbuch") which is further developed in order to well interface with energy issues, but also (ii) conservation related non or minor destructive testing (NDT) technologies (as e.g. IR-thermography, ground penetrating radar, ultrasonic tests) as well as (iii) energy performance related diagnosis (as e.g. again IR-thermography, blower door test, heat flow measurements).

Development and Optimisation of Solutions

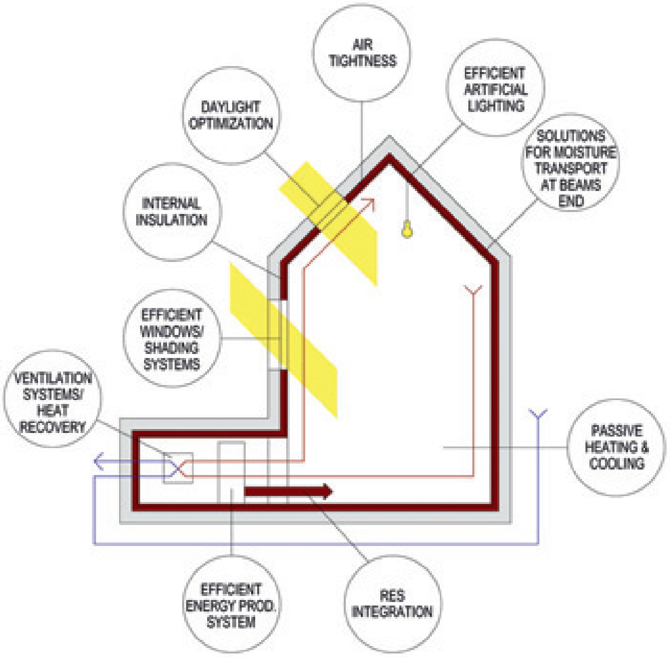
The selection of retrofit interventions has always to target the performance of the building as a whole - including envelope, energy system and users (Figure 2). The following section illustrates the specific research & development tasks tackled with the project.

Table 1. Partner list and roles within the multidisciplinary consortium (TS = technical solutions, UC = Urban context, C = conservation, D = Dissemination). Responsibility for a case study is also indicated.

Name	Country	Case study	TS	UC	C	D
EURAC research (EURAC)	IT	x	x			
The Royal Danish Academy of Fine Arts (KA)	DK	x		x		
Institut für Denkmalpflege und Konservierung an Denkmalen (IDK)	DE				x	
Universität Innsbruck (UIBK)	AT	x	x			
ARUP	UK		x			
Universität Darmstadt (TUDA)	DE	x	x			
CARTIF	ES	x	x			
Bartenbach Lichtlabor (BLL)	AT		x			
TU Dresden (TUD)	DE	x	x	x	x	
Comune di Bologna (COBO)	IT	x		x		
Passivhaus Institut (PHI)	DE		x			
TNO	NL					x
Università di Bologna (UNIBO)	IT	x	x		x	
Artemis	IT				x	
Elettronica Gelbison	IT		x			
Grupo Unisolar (G1S)	ES	x	x			
Menuiseries Andre	FR		x			
Remmers	DE		x			
ATREA	CZ		x			
youris	BE					x
ICLEI	DE			x		x
REHVA	BE					x



1. IR-thermography of CS5 – early concrete building used as a school in Innsbruck, Austria [3] (source IDK).



2. Passive & active energy retrofit solutions targeting the whole building's performance.

Integrated Monitoring & Control

By integrating both conservation and energy related tasks in the monitoring and control concept, damage mechanisms can be avoided, guaranteeing comfort – for people as well as the valuable building and heritage collections – with the least possible energy effort.

Development of Solutions

For new buildings the "passive house" is state of the art and well established in several European regions. Solutions for different climatic areas are available – even if more experience exists for cold climates than for hot ones. Also for existing buildings the refurbishment to very low energy demand is possible and economically convenient [4], but it is not yet as frequent. However, policy in Europe pushes hardly towards zero-emission - for new buildings, and substantial demand reduction - for existing ones [5].

In historic buildings, the energy refurbishment poses yet more questions to be solved. A first review of realised example done before project start and reported in [1], illustrates, however, that for historic buildings too, energy refurbishment potentials between Factor 2 and Factor 10 are feasible. A general target is nevertheless impossible to define, since relevant conditions for each individual building vary too much.

3ENCULT aims at developing necessary solutions, both adapting existing solutions to the specific issues of historic buildings and developing new solutions and products. In the following subsections the main treated themes, state of the art and planned development in the project are outlined.

Internal Insulation

Given the highly decorated facades, in historic buildings interior insulation is often the option of choice – even if less "failure safe" than exterior insulation from hygrothermal point of view. There are two major groups of insulation systems: vapour tight constructions (vapour barrier) and surface active (such as cellulose and calcium silicate) materials, the latter being more intrinsically safe but usually limited in thickness (and thus reachable performance).
Within 3ENCULT constructive details for "safe" solutions are illustrated and a highly efficient capillary active insulation is being developed.

Air Tightness and Moisture at Beam Ends

A not sufficiently airtight building does not only loose considerable heat by unwanted ventilation, but risks also thermal discomfort, structural damage (due to condensate) to the historic construction and poor air quality. For new buildings excellent air tightness can be achieved with reasonable effort and comparable results have recently been reached in refurbishments of post-war apartment buildings. Improving air tightness in historic and listed buildings is more challenging, though, because there are restrictions to the application of certain solutions and because the material of the buildings does not allow for standardised measures.
One of the main difficulties when improving air tightness in refurbishments is the split and uneven wooden beams (joists and rafters), which cut a new air tightness layer No reliable and economic solutions are currently available. Within 3ENCULT designated products as well as other products, which might be suitable, are tested in laboratory and/or on-site. Moreover with multidimensional hygrothermal modelling the risk of moisture damage in beam ends in case of air leakage is assessed for different leakage rates.
Based on these experiences recommendations on how to seal those penetrations of the air tightness layer will finally be formulated.

Efficient Windows

Highly efficient windows – in terms of glazings and frames – are available for both insulation as well as heat protection. For application in retrofit of historic building, aesthetic features such as the width of the frame and partition have to be considered as well. Moreover the installation of the window avoiding thermal bridges and guaranteeing air-tightness is more challenging in historic buildings (e.g. with interior wall insulation). The existing very low energy window technology and installation details will be developed further, in order to meet the requirements which emerge in one or several of the study case buildings.

Ventilation and Air Flow Balancing

A safe way for moisture proofing is controlled ventilation. Hence the retrofitting or installation of ventilation systems is the consistent step after the enhancement of the air tightness of the building. In terms of energy efficiency and comfort, ventilation systems with heat recovery are the best solution. However, in existing buildings for retrofitting of air ducts and the heat exchanger only limited space is available. During the last years, new heat exchanger systems with flat cabinets were developed for integration within the ceiling suspension.
In 3ENCULT the further step is done: ventilation systems to be integrated in the wall are being developed, benefiting from ad-

3. Presentation of a prototype as basis for discussion at the 3ENCULT window workshop – outer wing can keep original single glazing (source PHC/ANDRE).

vantages as short distance to the air inlet/outlet as well as the space saving position, and considering especially aesthetic limitations in historic buildings.

Furthermore the energy and cost savings, which can be reached by the automatic balancing of the flow volumes in ventilation systems is quantified and accuracy is examined and optimised. Imbalances between outdoor air and exhaust air flow would result in high or low pressure in the building and respectively to air exchange through leaks in the envelope – which is in historic buildings an even more serious threat because associated not only to thermal losses but potentially also to structural damage.

Daylight and Artificial Light Optimisation

In historic buildings the usually rather small windows (compared to the extensive use of glazed facades in modern architecture) and very thick walls leading to deep window reveals reduce the incoming daylight considerably – so that typically the main challenge is to bring enough daylight into the rooms, while at the same time keeping the room's structure and character.
On the market different shading techniques are available (e.g. Venetian blinds), but while these focus on shielding the radiation and thus also the daylight, 3ENCULT has the aim to develop conservation compatible light guiding and redirecting systems: these avoid glare and thus enhance comfort by controlling the luminance (brightness) and at the same time permit daylight to pass in the room.

In historic buildings with important interior furniture and/or decoration it is also a major challenge to find high efficient and high quality lighting solutions which fit into the context of the room resp. building in an unobtrusive and non-invasive way or even accentuate this context. As specific conservation-compatible developments 3ENCULT addresses (i) the use of projector-mirror-systems, which put in place mirrors without power connection instead of luminaires - for situations where laying electric wires would be too invasive, (ii) the development of LED solutions for situations, where access is restricted and lifetime an important issue (>100'000 h!), special integrated solutions benefit from the LEDs design flexibility and brilliant light or cold spectrum light is asked, (iii) the elaboration of a guideline which points out the three trades, which have to be considered when retrofitting a lighting installation: the lamp (light source, including controls and ballasts), the luminaire, and the room.
A comprehensive solution targeted to the specific room will highly outclass a standard replacement of incandescent with compact fluorescent lamps - which however has its importance, but bears also both aesthetical and visual issues especially in historic building contexts.

Impact of Thermal Mass

For centuries, the vast majority of European and Middle East residential buildings have been built using massive wall technologies. They have made life without air conditioners relatively comfortable even in countries with hot climates such as Spain, Italy, or Greece. However, also internal loads (lighting, electric appliances, etc.) have increased and worsen the situation. Dynamic simulation tool will be used in order to define the potential contribution of the building mass (usually high for historical building) and possible solution to increase the building thermal capacity.

Efficient Energy Supply and RES Integration

Existent efficient energy supply and distribution solution will be put in an organised inventory trying to define categories in order to best face different kind of historic buildings.
Solar technologies' (both thermal collectors and thin-film PV cells) compatibility with the architectural work is investigated for new designs of geometries, reflectance, colours, textures, also using new materials.

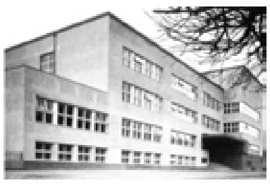
Case Studies

The research activities are accompanied and stimulated by different case studies. At the same time, these allow the assessment of the developed solutions. From here an analysis is conducted to generalize proposed solutions, identify replicable factors and the context where replication is possible.

3ENCULT contributes to the diagnosis, supports the design and planning phase and gives feedback with its monitoring. The project cannot, however, contribute financially to the intervention itself. It was thus important to select case studies, where the owners are committed to implement dedicated solutions and where the planned intervention's time schedule matches the project's time schedule.

The single selected case studies, shortly described in Table 2, do have different time schedules – what allows to focus on specific aspects as diagnosis, design support or monitoring also in the limited duration of a research project (10/2010 to 03/2014). In Copenhagen [6] e.g. the design process – already before inclusion in the research project – started with the detailed description of the heritage value of each building in the ensemble and a long list of possible interventions. In several stages with each time more detailed calculations and simulations an interdisciplinary group excluded the not appropriate options, until in the end the best suited intervention could be defined. The approach is analysed in 3ENCULT and replicated at other case studies.

Table 2. List of case studies within 3ENCULT project.

 [source EURAC]	**CS1 – Public Weigh House, Bolzano (IT)** Object: Romanesque origins (13th century). Rehabilitation intervention necessary. Use: commerce, residential, (exhibition). Owner: Stiftung Südtiroler Sparkasse. Proposed activities: diagnosis & support for architecture competition, support during planning phase (insulation, windows, energy system), transfer to urban scale.
 [source COBO]	**CS2 – Palazzo d'Accursio, Bologna (IT)** Object: 13th century nucleus, developed over centuries. Use: museum, public administration. Owner: Comune di Bologna. Proposed activities: diagnosis & NDT, support during planning phase (insulation, windows, HVAC, lighting), transfer to urban scale.
 [source UNIBO]	**CS3 – Palazzina della Viola, Bologna (IT)** Object: 15th century, lightened by double open gallery, enriched with frescoes and painted wooden ceilings. Intervention and functional requalification planned. Use: university. Owner: University of Bologna. Proposed activities: diagnosis & NDT, modelling - verification of interventions.
 [source KA]	**CS4 – Fæstningens Materialegård, Copenhagen (DK)** Object: Built mid of 18th century, part of the fortress next to Frederiksholm Canal. Use: public administration. Owner: Realea (Foundation). Proposed activities: diagnosis & NDT, monitoring, transfer to urban scale.
 [source UIBK]	**CS5 – Höttinger School, Innsbruck (AT)** Object: Building from 1929-31, Architect Franz Baumann, early building in concrete. High energy demand, overheating, low air quality, problems with humidity. Use: school. Owner: Innsbrucker Immobilien GmbH. Proposed activities: high efficiency passive house windows with integrated shading, insulation of walls and roof, ventilation system with heat recovery.
 [source TUD]	**CS6 – Warehouse City, Potsdam (DE)** Object: Schinkelspeicher (19th century), refurbishment already completed, monitoring data available to 3ENCULT. Persiusspeicher (17th century), refurbishment planned. Use: Residential, offices, exhibition. Owner: Speicherstadt Potsdam. Proposed activities: diagnosis of historical constructions, development of energy efficiency solutions (insulation, windows, energy system).
 [source CARTIF]	**CS7 – University Building, Bejar/Salamanca (ES)** Object: Salamanca University Building. Project in advanced state, (photovoltaic galleries, semi-transparent atriums, analyse air tightness). Proposed activities: diagnosis of historical constructions, support in design phase.
 [source TUDA]	**CS8 – Strickbau building, Appenzell (CH)** Object: Typical wooden construction, dating back to 17th century. The owner has the permission to dismantle the old building with the constraint to make it available to research for one year. This allows for outstanding activities! Proposed activities: to analyse behaviour of wooden constructions after extreme interventions, to use destructive analysis techniques usually not applicable on historic wooden buildings, to realise different thermal and moisture conditions.

Conclusion

Even if the definition of historic buildings is not restricted to "protected" or "listed" buildings, their energy refurbishment should be subject to particular attention, both as regards conservation and aesthetical [7] [8] as well as structural and building physics related issues [9]. Interventions need interdisciplinary collaboration and more effort, since "standard solutions" cannot be defined.

3ENCULT postulates (i) a holistic approach, (ii) the performance of the whole building as target and (iii) the intervention to be developed for each specific case supported by multidisciplinary exchange. The project develops both specific guidelines and solutions to be considered – which will however not suit each case! – as well as methods and tools to support the above multidisciplinary approach.

Acknowledgement:

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Enfoque holístico e intercambio multidisciplinario hacia el uso eficiente de la energía en los edificios históricos respetando su valor patrimonial

El proyecto europeo 3ENCULT demuestra que la reducción de la demanda de energía en un factor de 4 a 10 puede ser también factible en los edificios históricos respetando su valor patrimonial, si se aplica un enfoque multidisciplinario que garantice soluciones de elevada calidad y uso eficiente de la energía y que esté dirigido y adaptado a cada caso específico. Veintidós participantes, que incluyen expertos técnicos, en conservación y desarrollo urbano, socios de la industria y asociaciones de actores, colaboran en el desarrollo tanto de métodos como de herramientas que respalden el enfoque holístico, el intercambio multidisciplinario y las soluciones técnicas necesarias, mediante la adaptación de soluciones de modernización existentes a los problemas específicos de los edificios históricos y el desarrollo de nuevas soluciones y productos. Se demostrarán y verificarán las soluciones a través ocho casos prácticos.

Este enfoque holístico incluye:
– diagnóstico integral;
– desarrollo y optimización de las soluciones;
– monitoreo y control integrado.

Para los edificios nuevos el diseño pasivo es lo más avanzado y está bien establecido en varias regiones de Europa. Existen soluciones para diferentes zonas climáticas, aun cuando hay más experiencia para los climas fríos que para los cálidos. Además, para los edificios actuales también es posible y económicamente conveniente la renovación para lograr una demanda de energía muy baja, aunque todavía no es frecuente, a pesar de que existe una gran presión en Europa por tener edificios nuevos con cero emisión, en el caso de las construcciones nuevas, y por reducir la demanda de manera sustancial para las ya existentes.

En los edificios históricos, la renovación plantea aún más problemas que resolver. 3ENCULT busca el desarrollo de esas soluciones, adaptando las que existen en el presente a los problemas específicos de los edificios históricos y desarrollando nuevas soluciones y productos.

Se están desarrollando soluciones en los siguientes subtemas:

– Aislamiento interno
– Hermeticidad del aire y humedad en los extremos de las vigas
– Ventanas eficientes
– Equilibrio entre la ventilación y el flujo de aire
– Optimización de la luz natural y la luz artificial
– Impacto de la masa térmica
– Suministro eficiente de energía e integración de sistemas de energía renovable (RES)

Las actividades de investigación están acompañadas y estimuladas por diferentes casos prácticos que permiten evaluar las soluciones desarrolladas. A partir de allí se realiza un análisis para generalizar las soluciones propuestas, identificar los factores replicables y el contexto donde es posible la replicación.

La renovación de la energía en los edificios históricos debe ser una materia de especial interés, tanto en lo que tiene que ver con la conservación y la estética como lo relacionado con la estructura de la construcción. Las intervenciones requieren mayor esfuerzo y colaboración interdisciplinaria, ya que no se pueden definir "soluciones estándar".

Sustainable Design Approach to Preservation Centers
Principles applied from the design development phase to implementation for Library and Archives Canada's cellulose Nitrate Film Preservation Facility

by Martin Turpin, Capital Project Manager, Library and Archives Canada

Library and Archives Canada (LAC) recently completed a nitrate film preservation center in Ottawa, Canada, merging strict conservation requirements and sustainable design principles. The facility houses LAC's nitrate based holdings, which cover many of Canada's important efforts during the First and Second World Wars. Other well-known archival holdings, such as the country's early work in filmmaking (Back to God's Country, 1919) and Yousuf Karsh's earliest photographic work are kept in the preservation vaults. The project team demonstrated leadership in the area of sustainable design which resulted in a building having a minimal impact on the environment. Their work was recognized with the Public Service of Canada Innovation Award.

1. Library and Archives Canada's cellulose Nitrate Film Preservation Facility. Photo by Gordon King, 2011.

Design Intent

When the design began in 2003, Library and Archives Canada decided to make it a priority to build a green facility. The building's function as a preservation facility requires a high level of energy to preserve its collection at 2°C and 25% relative humidity, which is the environment required to ensure that the cellulose nitrate films and photographic negatives are well preserved. While the project team opted to use the same approach to design the facility as the LEED standard (set by the Canadian Green Building Council), with the available technologies, they did so without pursuing the accreditation because of the building's high energy consumption and distance from the downtown core.

Some concepts adopted for the project included a simple volume facility with an exterior building envelope comprised of a green roof, super insulated walls, and high-efficiency windows. The mechanical and electrical systems include energy recovery ventilators, instant hot-water systems, and occupancy light controls with LED/fluorescent light fixtures. Care was taken to nestle the building within the site's bedrock, orienting it to minimize site excavation.

The archival processing room and digitization room were designed to be interchangeable and are equipped with adaptable workstations, allowing flexibility for future conservation and digitization technologies. These rooms, located on the northern side of the facility, highlighted in red in the following rendering (see fig. 2, p. 38), include large high-efficiency windows that are more airtight and provide superior insulation value than regular window systems. While the inclusion of high-efficiency windows was for the benefit of the occupant comfort, the northerly direction of each room helps reduce the heat load and avoids direct sunlight on the collections handled in these rooms.

The preservation vault wing, represented in blue in the same rendering, required thick walls for fire separation. These walls were also used as structural support for the green roof, saving the cost premium to support the weight of the green roof and helping to expedite the construction process. The utilization of fly ash in the concrete helped to reduce the quantity of Portland cement, lessening the environmental impact, improving the fire resistance, and reducing the wall thickness.

Extensive Vegetative Green Roof

The main advantage of incorporating the vegetative roof was to provide a buffer zone between the 2°C environment (of the preservation vaults), and the outside heat during the summer months. According to research by National Research Council Canada, a green roof will reduce the summer peak roof temperature from 70°C, on typical tar roofs, to 30°C on a green roof. To best explain this, it is the equivalent of the temperature of a grass lawn versus paved asphalt on a hot summer day. Therefore, you only need to cool 28°C (30°C minus 2°C), on a green roof, versus 68°C (70°C minus 2°C) for a typical tar roof. In addition, a green roof will reduce the load on the city's water treatment plants by eliminating the water runoff, and extend the life of the roof membrane by 30 years.

Energy and Water Efficiency

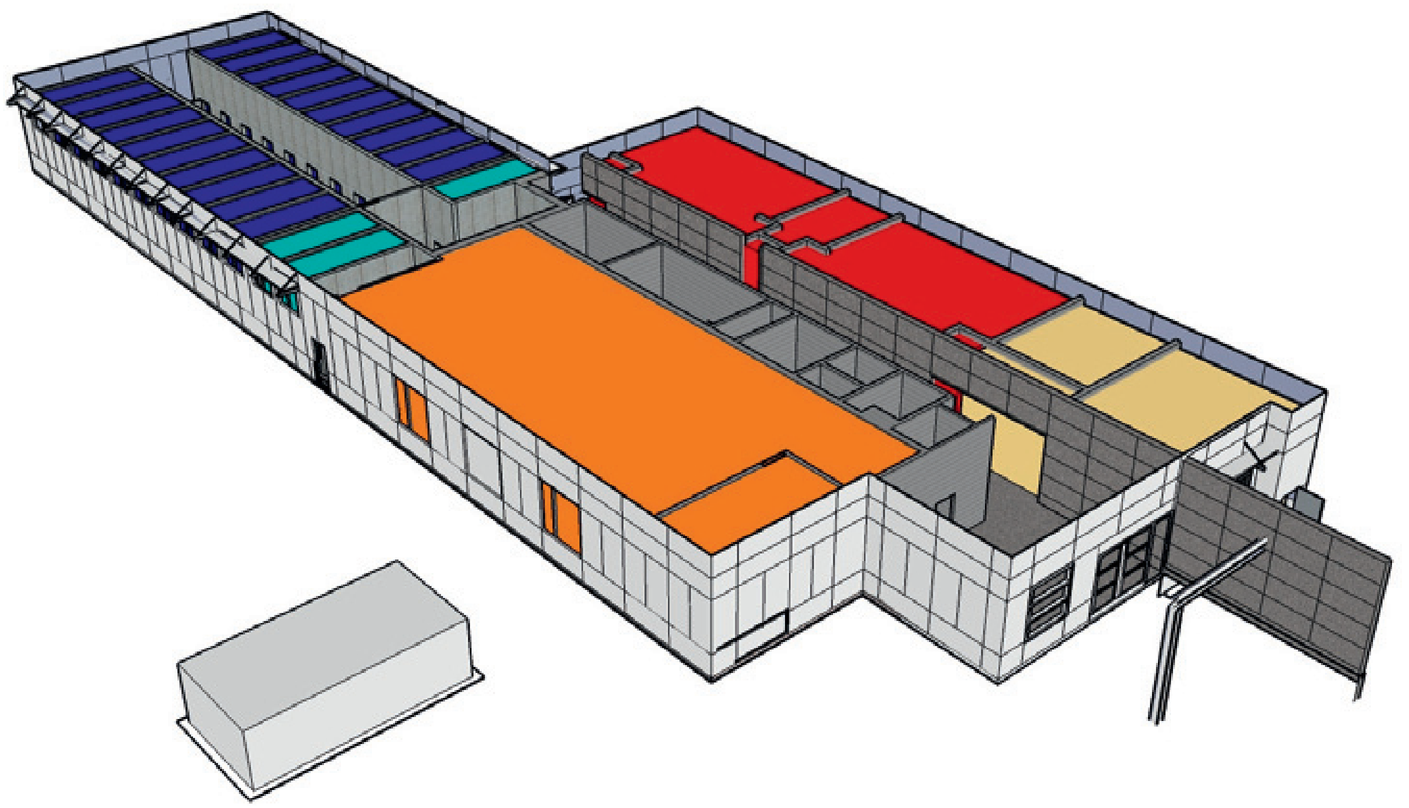
The energy performance of the building was maximized through the selection of appropriate building components and systems. Utilizing super-insulation construction details and capitalizing on thermal massing helps to retain the ambient temperature in the space, thereby lessening the need for cooling or heating. To explain this in a simpler way, think of your home refrigerator. It is more efficient when it is full than empty because the content (mass) helps to retain the desired temperature without continuously cooling the inside of the refrigerator.

Another initiative to reduce air loss was the introduction of the acclimatization corridor in the preservation vault area which reduced the leakage of conditioned air in the adjacent occupied spaces. And finally, the inclusion of a green roof over the preservation vault area contributes to the reduction of the cooling load on the mechanical systems.

Due to the preservation vaults being kept at 2°C, the vault wing functions as a large refrigerator. Consequently, efforts to design the mechanical system to minimize energy use include an independent Energy Recovery Ventilator (ERV) and Variable Speed Drives (VSD). The ERV recovers the energy from the vault exhaust air and reuses this energy to cool the fresh air going into the building, while the VSD, on the building's mechanical systems, operate only when required and to the level of the occupant load instead of running continuously.

Instantaneous hot water heaters, for all domestic water heating, eliminate the energy wasted with hot water tanks when they are not in use. Therefore, energy is used only when the occupants need it. Duty boilers are used to provide the necessary heat to the desiccant wheels for dehumidification in the preservation vaults. To make the most of the boilers, they are also used for supplemental radiant heating to the occupied spaces and to complement the heating, ventilation and air conditioning systems to improve individual control of these spaces and occupant comfort. Efficient fluorescent and LED fixtures, controlled with occupancy sensors, were used in the facility to reduce the energy load. Occupied spaces are outfitted with large windows to maximize daylight and the metal roof decking, which acts as the finished ceiling, is painted white to reflect as much light as possible into these spaces.

Water consumption for the facility is reduced by providing touchless (for improved sanitation) low-flush fixtures, and drought-resistant plants for the green roof and the site. The landscaping is a managed meadow of native species with only a small portion requiring maintenance, thus reducing ongoing maintenance costs. The landscape architect was committed to returning much of the site to its pre-development state, using indigenous species.



2. Rendering of the Nitrate Film Preservation Facility.

Blue: preservation vaults **Red:** laboratories **Beige:** loading dock area **Yellow:** mechanical room

Carbon Footprint

In order to reduce our environmental impact, the criteria used to source the building finishes were based on: local products (to reduce transportation from the producers to our door), durable products with the same lifespan as the building, and products that require little to no maintenance. Such products include interior and exterior metal walls (using 25% recycled content) that were painted off-site to avoid the introduction of pollutants in the laboratories and occupied spaces.
Using polished concrete floors and poured concrete walls, with the maximum amount of post-industrial recycled material (fly ash), and exposed architectural concrete blocks, eliminating cyclical replacement and maintenance of these finishes.

Exposing the roof decking and structure not only allows light reflection from the light fixtures, but also provides easy access for maintenance work, eliminating the need for a suspended ceiling. Careful consideration was made in the selection of the cabinetry for the kitchen and washrooms, which were constructed with rapidly renewable agricultural fibers and Forest Stewardship Council Canada (FSC) wood. The interior design eliminates all unnecessary applied finishes and exposes the structural and mechanical building systems (which are used as design elements).

Conclusion

Even with the construction completed, LAC continues to promote sustainable practices by educating the occupants and visitors about the benefits of sustainable design, specifying green maintenance practice (using non-toxic products that have minimal impact on the environment) in the facility, and through active design—a shower facility was included in the building to encourage employees to lead active lifestyles at the workplace.

Building construction has a significant impact on the use of non-renewable resources as well as our environment. This is especially true when it comes to collection facilities, designed with high preservation standards, which often consumes a lot of energy. Creating the optimal preservation condition was paramount in the design of the facility in order to preserve Canada's nitrate-based documentary heritage for present and future generations. While using a sustainable design approach, the project team managed to construct the "coolest", at 2°C, nitrate film preservation center in North America while minimizing its impact on the environment and reducing its carbon footprint.

Project Team

Prime consultants: Schoeler & Heaton Architects
Sub-consultants:
Mechanical/electrical: Goodkey Weedmark & Associates
Landscape architect: F.D. Fountain Landscape Architecture
Structural: Adjeleian Allen Rubeli
Commissioning: Cathcart Mechanical Performance
Site services: Stantec Consulting

General contractor: Laurin Group

3. Main entrance area. Photo by Gordon King, 2011.

Publication

Just released: *New approaches to Book and Paper Conservation-Restoration*. 2011. Ed. by Patricia Engel, Joseph Schirò, René Larsen, Elissaveta Moussakova, Istvan Kecskemeti. Wien/Horn: Verlag Berger.

This publication follows the conference "New Approaches in Book and Paper Conservation-Restoration in Europe" which took place in Austria, Horn, from 9th to 11th of May 2011.

It summarizes the needs for further research in the field of book and paper conservation and represents an understanding of this task under the current state of affairs and from the most comprehensive point of view possible. Librarians, archivists, heads of print and drawing collections, conservators and historians as well as art historians and natural scientists have all been consulted in an attempt to discover what exactly is needed to safeguard our written cultural heritage.

New Approaches to Book and Paper Conservation-Restoration. 2011. Edited by Patricia Engel, Joseph Schirò, René Larsen, Elissaveta Moussakova and Istvan Kecskeméti. Wien/Horn: Verlag Berger, XXIV, 748 pp., ISBN 978-3-85028-518-6; 2.
Available at Verlag Berger.

Events

Announcements

British Library Preservation Advisory Centre Training Day on "Preventing pests by IPM", 8 February 2012, British Library Centre for Conservation, London, UK

Led by David Pinniger, Independent Consultant Entomologist, this one-day workshop provides an introduction to preventing pests through use of integrated pest management. The course is aimed at anyone with any involvement with, or responsibility for care of libraries, archives and collections. Technical handouts will be given to support the course.

Course objectives:

- To introduce the main insect pests which attack collections: what they need to live: how to identify them: the damage they cause; ways to prevent them becoming established;
- Understanding pest environments;
- Selecting the most appropriate treatments to control pests;
- Making plans to establish an Integrated Pest Management (IPM) programme.

The programme and registration form are available at:
http://www.bl.uk/blpac/pests.html

Registration fees: £120.00

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IFLA International Newspaper Conference, Bibliothèque nationale de France, 11-13 April 2012, Paris, France

The Bibliothèque nationale de France, the IFLA Newspaper Section and the IFLA PAC Core Activity are pleased to announce the IFLA International Newspaper Conference 2012 in Paris, at the BnF Grand Auditorium, on April, 11-13, on the topic: **"Newspaper Digitization and Preservation: New Prospects. Stakeholders, Practices, Users and Business Models."**

After New Delhi (2010) and Kuala Lumpur (2011), the next IFLA International Newspaper Conference will be held in Paris, during a major exhibition dedicated to the History of the Newspapers in France at the BnF.

The National Library of France (currently involved in a large scale newspaper digitization programme) and the IFLA Preservation and Conservation Core Activity (PAC, hosted by the BnF) are co-organizers of the event. The Conference aims to assess major ongoing mass digitization projects in Europe and throughout the world, undertaken by libraries, archives, newspaper publishers, and content aggregators. In addition to digitization projects, conference topics are: general digitization policies, web harvesting, legal deposit, editorial strategies, issues linked to long-term digital and physical preservation, new devices for access and distribution of digital content, as well as new and old business models.

Conference sponsors' latest products and technologies will be on display in the Grand Auditorium foyer.

In "Le LABO" area of the BnF, conference attendees will be able to see and use the most up-to-date technologies and e-reading devices for news and digital newspapers online.

Target group:
Librarians, archivists, news publishers, journalists, experts in media economics, digital and physical preservation experts, digital service providers, news and content aggregators, and producers of new electronic devices are invited and encouraged to attend.

Conference languages: English and French. Simultaneous translation will be provided.

Conference website:
http://www.ifla.org/en/events/ifla-international-newspaper-conference-2012

Registration:
Registration is now open.

Fees: 120 € for 3 days / 50 € for 1 day

Sponsorship: would you be interested in supporting? Visit the conference website to learn more about our sponsorship programme.

Contacts :
Christiane Baryla, IFLA PAC Director:
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Frederick Zarndt, Chair, IFLA Newspaper Section:
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Pascal Sanz, Director Department Law, Economics, Politics, BnF:
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Conférence internationale 2012 sur la Presse, Bibliothèque nationale de France, 11-13 Avril 2012, Paris, France

La Section Journaux, le Programme PAC (Préservation et Conservation) de l'IFLA et la Bibliothèque nationale de France sont heureux d'annoncer la Conférence internationale 2012 sur la Presse qui se tiendra du 11 au 13 Avril dans le Grand Auditorium de la BnF, sur le thème suivant : « **Numérisation et Conservation de la Presse : nouvelles perspectives. Acteurs, pratiques documentaires, usages et modèles économiques**. »

Après New Delhi (2010) et Kuala Lumpur (2011), la Conférence internationale sur la Presse de la Section journaux de l'IFLA se tiendra à Paris, à la BnF sur le Site François Mitterrand où sera présentée en même temps une grande exposition dédiée à l'Histoire de la presse en France.

La Bibliothèque nationale de France, engagée dans un vaste chantier de numérisation de la presse, et le programme PAC (Préservation et Conservation) de l'IFLA qu'elle héberge, participent à l'organisation de cet événement. L'objectif sera de faire le point sur des grands projets de numérisation de masse, en Europe et dans le monde, entrepris par des bibliothèques et des archives, mais aussi par des entreprises de presse et des agrégateurs de contenu.

Outre les projets de numérisation, les thèmes de la conférence porteront sur les stratégies de conservation inhérentes aux politiques générales de numérisation, sur la collecte du web, le dépôt légal, les politiques éditoriales, la conservation à long terme des données numériques et des collections originales. La multiplication des supports d'accès et de diffusion des contenus numériques et les modèles économiques nouveaux et anciens seront aussi à l'ordre du jour.

Dans le foyer du Grand Auditorium, les sponsors présenteront leurs matériels.

Dans l'espace « LE LABO » de la BnF, les participants pourront voir et utiliser tablettes électroniques et nouveaux supports qui donneront accès à de nombreux titres de journaux en ligne.

Public concerné :
Sont invités à participer les bibliothécaires, archivistes, éditeurs, journalistes et économistes des médias, experts en conservation traditionnelle ou numérique, agrégateurs de contenu et de news et fournisseurs de service de numérisation et de nouveaux supports électroniques.

Langues de la Conférence : Anglais et Français. La traduction simultanée est prévue.

Site web de la Conférence : http://www.ifla.org/en/events/ifla-international-newspaper-conference-2012

Les **inscriptions** sont ouvertes.
Tarif : 120 € pour les 3 jours
50 € pour 1 journée

Sponsoring: si vous souhaitez soutenir cet événement, merci de consulter les différentes options de sponsoring sur le site de la conférence.

Contacts :
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AIC 40th Annual Meeting on "Connecting to Conservation: Outreach and Advocacy", 08-11 May 2012, Albuquerque, USA

The theme of the American Institute for Conservation of Historic and Artistic Works (AIC) annual meeting will be outreach and advocacy in conservation, an exploration of how conservation connects with allied professionals, the press, our clients and the general public. This meeting will feature a General Session format very different than in years past. For the 40th Annual Meeting, in addition to one session where all attendees gather to hear a selection of presenters, there will be other breakout sessions where a wide array of topics pertaining to the overall theme will be addressed in topical conversations presented in smaller group settings rather than a large lecture format.

Information:
www.conservation-us.org/

Registration fees:
Early Rates (1/1/2012-2/28/2012):
Members: $335
Students members: $145
Non-members: $425

Contact:
Adam Allen:
aallen@conservation-us.org

Indoor Air Quality 2012 Conference, "Standards and Guidelines", University College London, Centre for Sustainable Heritage, 17–20 June, 2012, London, UK

The IAQ International Scientific Committee and UCL Centre for Sustainable Heritage have the pleasure to announce the 10th International Conference on Indoor Air Quality in Heritage and Historic Environments, which will be held at the University College London, Centre for Sustainable Heritage, London, UK, on 17-20 June, 2012.

The conference is the 10th in the series of conferences dedicated to the research and knowledge exchange in the field of indoor air quality in historic and heritage environments in museums, galleries, archives, libraries and historic houses. The IAQ series was set up in 1998 to advance knowledge of pollutants and their effects on heritage collections. Since then, the remit of IAQ conferences has expanded to cover indoor environment-induced degradation, pollutant mitigation, climate control and modelling, air quality monitoring, air quality standards and guidelines. Both applied and original research contributions are highly welcome, including reviews of relevant research topics. Presentations by conservators, curators and museum professionals are as welcome as those by scientists.

In 2012, on behalf of IAQ, UCL Centre for Sustainable Heritage is particularly pleased to host this important event. The focal topic of IAQ 2012 is "Standards and Guidelines", reflecting the amount of recent activity and the needs of heritage stakeholders. Presentations are therefore invited particularly if they cover research and applications underpinning the development of standards and guidelines.

Please see the website for details on registration, abstract submission and fees: http://www.ucl.ac.uk/iaq2012/

The abstract submission deadline is January, 5, 2012.

This conference is part of 10th anniversary programme of the UCL Centre for Sustainable Heritage (2001-2011).

IFLA WLIC 2012 Satellite Meeting: "The Electronic re-evolution. News Media in the Digital Age", August 7-9, 2012, Newspaper section, Mikkeli, Finland

During the IFLA Congress 2012, the Newspapers Section will organize a three-day preconference entitled "The Electronic re-evolution", on August 7-9, 2012, in Mikkeli, Finland. This preconference will be a joint partnership with the IFLA Preservation and Conservation Section, IFLA PAC Core Activity and the IFLA Genealogy and Local History Section.

Theme and Objectives:
The expected audience will likely include librarians, archivists, digital curation specialists, publishers, researchers and historians. Both conferences will deal with the impact

of the electronic re-evolution on the newspaper field at large including e-delivery, user participation, digital environment, and copyright issues. We will also look at the impact on (digital) preservation solutions, collection management, and physical storage.

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Call for Paper: "Climate for Collections: Standards and Uncertainties", 7-9 November 2012, Doerner Institut, Munich, Germany

On the occasion of its 75th birthday, the Doerner Institut is organising a conference dealing with an urgent topic. Museum standards, high energy bills, complex air conditioning equipment, modern museum architecture and the effects of inappropriate indoor climate, are ongoing themes in discussions among preservation professionals. The Munich Collection Climate Conference in November 2012 will offer an excellent opportunity for conservators, curators, librarians, scientists, engineers and architects to discuss standards and uncertainties. Contributions are sought on observations of damage, damage functions, historic climate control concepts, the interaction of buildings and environment and predicted effects of climate change. This debate will lead to greater understanding of the factors to be balanced if we are to sustain the mission to save cultural heritage for future generations.

To find out more, download the Call for Contributions at: http://www.doernerinstitut.de/en/projekte/CollectionClimate/CollectionClimate_1.html

The Munich Collection Climate Conference is part of the institute's involvement into the EU project Climate for Culture. The conference will be organised in close co-operation with the German Conservator Association VDR and be supported by the International Association for Science and Technology of Building Maintenance and the Preservation of Monuments WTA.

The organising committee preparing the conference consists of grad. conservator Melanie Eibl (Munich), Prof. Dr. Jonathan Ashley-Smith (Cambridge), and Prof. Dr. Andreas Burmester (Munich).

Report

Report on "Pest Odyssey 2011: Ten Years Later", 26-28 October 2011, the British Museum, London, UK

More than 200 delegates attended the "Pest Odyssey 2011: Ten Years Later" Conference, which was a follow up to the highly successful event held in 2001. It was hosted by the British Museum and organised by Icon's Care of Collections Group in partnership with the British Museum and a wide range of other institutions, including English Heritage, the Natural History Museum, Historic Royal Palaces, the V & A, the Museum of London, the Horniman Museum and the Tate.

The main goal was to look at how Integrated Pest Management (IPM) has developed over the past ten years to deal with the increasing threat pest attacks poses to collections and buildings. The conference was opened by David Pinniger, the well-known entomologist who is the pest management strategy adviser for English Heritage and the major museums and historic houses in the UK.

David Pinniger reminded that IPM was now largely accepted and implemented in cultural heritage institutions. What has changed and will go on changing over the ten next years is: infestation by new species as the vodka beetle (*Attagenus smirnovi*), new methods or better use of existing methods for treating infested objects and an increasing constraint on energy budgets. IPM will be given more importance because it is more energy-efficient than objects treatment (by freezing or heating). Recent development in building design such as green roofs can also raise new issues in terms of pest monitoring.

Amber Xavier-Rowe from English Heritage also noted that the insect pest risk level is considered as relatively low compared to other risks such as the storage or display conditions, light, etc., that is why it is particularly important to raise public and management awareness on this issue.

During the conference, several institutions presented their own IPM, such as the Museum of London, or the control strategies that were implemented to fight infestation, for instance at the National History Museum of Dublin, the Victoria and Albert Museum, or in the Japanese National Museum of Ethnology which developed two customized computer programmes to monitor pest and climate.

As part of their IPM, cultural institutions use risk zones for mapping priorities. David Smith, from the National History Museum of London, developed with KE Software a Web mapping functionality to have an overview of the pest attacks, per species, per year, with the localization, which allows to establish a central repository for pest trapping data and mapping. Resources such as insect pest databases are also available like *What's eating your collections* (http://www.whatseatingyourcollection.com/) which records pest across the UK.

The use of traps, and particularly pheromone traps, was evoked as the best way to identify pest hot spots, observe seasonal patterns and check the effectiveness of pest prevention measures. Robert Child (Conservation Consultant) showed that the future of IPM will lie in a better interpretation of the trap catch and a better training of the staff for identifying pest and sources.
All the speakers note poor housekeeping and lack of building maintenance as the main sources of pest infestation.

Techniques for treating objects were presented: low temperature is the most widely used, compared to high temperature (notably, solar bagging, interesting solution for tropical area) and anoxia. Treatment of large objects (a canoe, attacked by drywood termites in the Australian Museum of Sydney) was evoked too. Anne Bancroft, from the Victoria and Albert Museum, showed how low temperature treatment of infested book collection was implemented in a tropical climate with limited resources (Barbados).

The speakers underlined how important training programmes are, as well as the formulation of guidelines. Tom Strang presented the guidelines for combating pest in cultural heritage institutions developed by the Canadian Conservation Institute (Ottawa). The difficulty lies in the fact the guidelines have to be flexible enough to be adapted in different countries and climates. The Integrated Pest Management working group, which gathers institutions from the US, Canada and Europe (www.MuseumPests.net), proposed resources too, such as methodologies and solutions of pest management, as well as a "Pest List", not to "reinvent the wheel" in case of infestation.

Recent research works were also presented, particularly the very interesting Attagenus smirnovi project led by Denmark, Sweden and Norway. It aimed at studying how the future climate changes will affect this pest indoor reproduction and food consumption in the Nordic area, reinforced by the increasing temperatures, causing new pest problems and more damage to collection (http://smirnovi.natmus.dk/).

Finally, the Whitworth Art Gallery showed how contemporary installation works of art pose new pest challenge and how the museums have to deal with it without alienating creativity, which implies more additional preparatory work in contact with the artist.

During the conference, exhibitors, mainly companies specialized in pest management, such as Exosect or Hanwel, presented their products and some posters were exposed too. The conference proceedings are available for purchase at:
www.english-heritageshop.org.uk

Further information on the Conference website: http://www.pestodyssey.org/

Report on 22nd Preservation Forum: "Disaster Preparedness in China, Korea, Australia and Japan: Reports from National Libraries", 1 December 2011, NDL, Tokyo, Japan

by Noriko Nakamura

IFLA-PAC Regional Centre for Asia held the Preservation Forum on December 1, 2011, at the NDL Tokyo Main Building and the Kansai-kan through the video conference system. There were reports from four national libraries which have PAC Centres in Asia and Oceania, and in addition a special report from the prefectural library in the areas stricken by the Great East Japan Earthquake. Ms. Li Cuiwei, Deputy Director of the Office of China National Center for Preservation & Conservation of Ancient Books (National Library of China), Dr. KuiBok Lee, Chief Conservator of the National Library of Korea, Ms. Jennifer Lloyd, Manager of the Preservation Services of the National Library of Australia, gave presentations on their libraries' collection disaster plans and other documents of the same type, training, cooperation, and experiences of disasters. Noriko Nakamura, Library Counsellor of the National Diet Library, reported its activities based on its principles to protect materials from disaster and its support for the areas stricken by the great earthquake. Ms. Kumiko Sakai, Head of the Iwate Prefectural Library, urged that continued cooperation and support are necessary to revive the damaged libraries as community centers to bring a full life back to the people. The number of participants was 93. After the Forum, the speakers also enjoyed a cultural tour to a paper mill to make Japanese paper. The above presentation is on the following NDL website and will be on the NDL website English page: http://www.ndl.go.jp/jp/aboutus/data_preserve29.html

1. At the Paper Mill Takano: (from left to right) Jennifer Lloyd, Manager of the Preservation Services of the National Library of Australia, Miran Kato, interpreter, Teizo Takano, Head of the Paper Mill Takano, Dr. KuiBok Lee, Chief Conservator of the National Library of Korea, a staff member of the mill.

2. From left to right: Kumiko Sakai (Head of the Iwate Prefectural Library), Jennifer Lloyd (Manager of the Preservation Services, National Library of Australia), Dr. KuiBok Lee (Chief Conservator, National Library of Korea), Li Kuiwei (Deputy Director of the Office of China National Center for Preservation & Conservation of Ancient Books, National Library of China), Michiko Kawanabe (Director of the Preservation Division, National Diet Libary).

PAC CORE ACTIVITY

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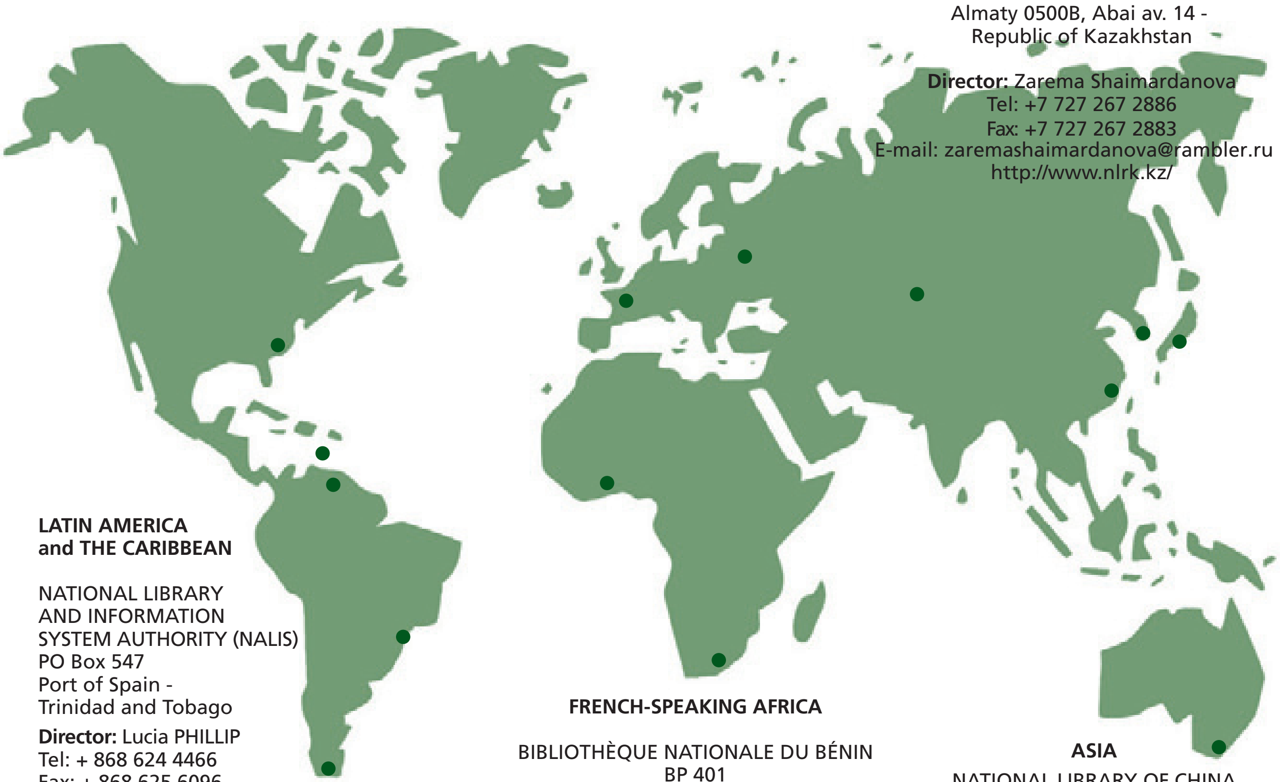

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