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.

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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. 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.

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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.

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].

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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/CEN-TechnicalCommittees/Pages/TCStruc.aspx?param=411453&title=CEN%2FTC+346 (accessed 15.01.2012).