

# SUSTAINABLE PASSIVE CLIMATE CONTROL IN DEVELOPING COUNTRIES: A CASE STUDY AT THE NATIONAL MUSEUM OF ART IN MAPUTO, MOZAMBIQUE

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## ABSTRACT

Passive climate control is often considered preferable to active control in developing countries. However, it is not necessarily easier to implement a passive system which will be sustainable. There are few conservators in the developing world and there is a lack of understanding of their work, making it hard to persuade other staff of its importance. Visiting conservation 'experts' can encounter problems due to the legacy of colonialism, and implementing solutions which appear to be 'cheap and cheerful' compared to those used in the developed world may be seen as demeaning. Time spent working with on-site staff to explain the methods used and get them involved will increase the chances of success in a project; however, winning the support of senior staff is the key, since they will be responsible for delegating tasks and ensuring the continuation of the project. In broader terms, changing approaches to climate control in the developed world, such as moves away from air conditioning towards cheaper and more fuel-efficient methods, will make passive methods more attractive to developing countries and may mean that their implementation will pose fewer problems in the future.

## INTRODUCTION

This paper concerns work carried out during an internship at the National Museum of Art in Maputo, Mozambique, in August 2003 and during May – September 2004 [1]. It describes the problems encountered by the museum with air conditioning and dehumidification units and efforts to establish an alternative, simple and cheap means of reducing the relative humidity (RH). While the methods used to reduce RH will be described, the focus of the article is on the difficulties involved in ensuring the sustainability of the passive climate control strategy.

Mozambique is in south-east Africa and has a sub-tropical climate, which means that it is extremely hot and humid during the European winter months and cooler and less humid during the European



Figure 1. The National Museum of Art in Maputo, Mozambique: front view

summer months. The National Museum of Art in Maputo was established in 1989 and is housed in a concrete former office building (fig. 1). The collection consists of modern and contemporary Mozambican paintings and sculpture with a small ethnographic collection and some colonial Portuguese paintings in storage [2]. An American conservator, Claire Gerhard, helped to establish a conservation department at the museum [3] and two Mozambicans, Jonas Tembe and Afonso Malace, were sent for conservation training in Lisbon, subsequently becoming permanent members of staff.

When I arrived at the museum in August 2003 there was no climate control. Records from thermohygrographs showed that RH in the exhibition areas ranged between 53% and 92 %, with monthly averages between 73% and 82%, while the RH reached 100% at times in the basement store. I was aware that some buildings produce good climates for museum objects, and that there is a danger of worsening the environment through attempts to control it [4]. I therefore took measures to establish whether or not the high RH in the museum was causing any problems for the paintings. A condition survey was carried out, and compared to a survey carried out ten years previously. The results indicated that the canvases had taken on large undulations and that paint had flaked, and was still flaking, on a



Figure 2. Rear view of the museum showing air conditioners on the first floor and dehumidifiers in the basement

large scale. It was clear that measures needed to be taken to improve the environment in the museum if the collection was to survive.

During my absence from the museum from September 2003 until May 2004 the museum director asked me to look into possible solutions for the environment. The conclusion I came to was that passive control would be most appropriate. Equipment for air conditioning and dehumidification not only costs money initially, but continues to incur costs due to maintenance requirements and electricity consumption; in addition, frequent power cuts might expose paintings to harmful fluctuations in temperature and RH. Even if a donation were to cover the cost of suitable units and their installation, their continued functioning would not be assured. I therefore decided to see whether the RH might be lowered by judicious opening and shutting of doors; this would cost nothing and would, theoretically, be completely sustainable.

Returning to the museum in May, however, I found that a donation had been spent on four air conditioning units for one of the galleries and two dehumidifiers for the basement store [5] (fig. 2). The air conditioners were domestic quality and were being used for the comfort of visitors during evening lectures. The dehumidifiers worked by condensation and drained straight into a trench running along the back wall of the museum; this meant that there was a danger of the water extracted from the air immediately re-entering the store through the walls and floor. The documentation provided by the company which installed the units noted that they were aiming for an RH of 35 – 50%. This seemed absurdly low, especially considering that the objects in the store had been acclimatised to very high humidity. This had occurred because

the units were installed by a company with no specialist knowledge of museums, in the absence of the museum’s conservators. In view of these problems, it seemed as well that no one on the staff knew how to use the dehumidifiers and that one of them was already broken. These new units had cost the museum \$7500 [6].

I had initially assumed that the main problem with conservation in the developing world was money. However, these difficulties with climate control units indicated that the most pressing problems lay elsewhere. The museum directorate had not used the specialist knowledge of its conservators before installing the units. The fact that the air conditioning was used primarily to create a comfortable climate for visitors also demonstrated that the museum’s role as a repository was secondary to its roles as a place of education and entertainment. These attitudes are unsurprising given that even in developed countries, where they are now relatively common, conservators often complain of a lack of understanding and respect.

Following my return to the museum, I was given permission by the museum director to devise a means of passive climate control. It was essential that this control should be established and maintained on the smallest possible budget; in this way there would no donors’ stipulations, no need to divert funds from other activities, and the climate control would, in theory, be sustainable indefinitely. Another motive for keeping the budget to a minimum was to persuade the museum’s conservators that they could carry out effective work using only the resources available to them. Both had expressed a reluctance to engage in work which they felt they would never be able to do properly because of a lack of equipment; as a result they were extremely de-motivated and disinclined to embark on any conservation projects. This circumstance only reinforced the directorate’s

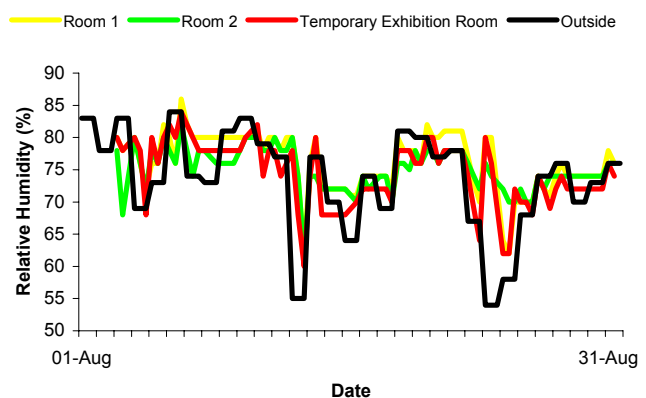


Figure 3. Chart showing the RH outside and in the three exhibition rooms during the month of August 1998.



Figure 4. View of the gallery in which the climate control experiment took place

impression that the conservators had nothing of value to offer the museum [7].

Records showed that there had once been thermohygrographs in the museum. The most recent calibration of these had been noted for April 1998, so I decided to take the subsequent months for comparison with the new figures which I would collect. Comparative data for a larger number of years would have been preferable, but records were often not sufficiently complete and could not be trusted without evidence of calibration. In order to see how the environment inside the museum related to that outside, RH and temperature readings for the relevant period in 1998 were obtained from the local meteorological institute. These were provided in the form of two figures per day – averages for the morning and the afternoon. Although this was not ideal, I thought that if I also made averages for the readings from the museum I would at least have two directly comparable data sets. Two dial hygrometers belonging to the museum were then calibrated at the meteorological institute. The only expenses incurred throughout the project were for these services.

Comparing the RH readings, it was clear that the RH inside the museum responded closely to that outside, but with fluctuations slightly smaller inside the building than outside (except in the basement store) (fig. 3). This suggested to me that large amounts of outside air were entering the building, particularly through the main museum doors, which were kept wide open throughout the day, so that the building had not developed an indoor environment distinct from that outside. Colleagues in Durban, which has a similar situation and climate to Maputo, told me that absolute humidity there was lowest just after midday, and the RH readings for the afternoon outside in Maputo were always considerably lower

than those for the morning. I decided, therefore, to try to encourage air into one of the galleries at dry times of day, by keeping the doors to the museum and the internal gallery doors open in the afternoons, and to exclude it as far as possible at more humid times by shutting the doors. In view of the lowest absolute humidity probably occurring just after midday, it might have been more effective to keep the doors open only for a short period in the early afternoon. However, I wanted to cause the least possible disruption to the museum's established routine, to give the strategy the best chance of sustainability. For this reason, the doors were kept shut from the beginning of the working day, at 7:30am, until the museum opened to visitors, at 2pm, and then the main doors and the doors of the gallery were kept open until the museum closed to the public, at 6pm (fig. 4).

It was essential to get the museum staff interested and involved in the experiment because, if it proved successful, it would be up to them to continue the regime after I left. In order to achieve this I outlined the experiment at a general staff meeting, in Portuguese, although my Portuguese was poor, rather than English, in order to win more sympathy. I was assisted at this meeting by the deputy museum director, who took a vote amongst the staff members on whether I should carry out the experiment. Since all of the staff would be involved in ensuring that the doors were kept in the correct positions as they went about their jobs, it was very helpful that they were given responsibility for the project in this way.

Despite these measures, however, there were problems getting the experiment started. The guards, though stationed close to the doors, were unwilling to close them during the morning if they were left open. In addition, they did not want to take readings at the weekends and between 3:30pm, when my working day finished, and 6pm, when they went home. Since some of this reluctance seemed to stem from a feeling that they were being asked to carry out menial tasks which I would never be willing to perform myself, I took the half-hourly readings from 7:30am until 3:30pm myself and made sure to check the doors frequently and adjust them if they were in the wrong position; I explained to the guards each time why I was doing this [8].

After about a week I found that readings were being taken in my absence, and an intervention by one of the museum's conservators ensured that the guards kept the doors in the right positions during the day. This intervention, though welcome, showed that the

reluctance to participate was due to the request coming from me, rather than a Mozambican colleague, and pointed to a resentment towards outsiders taking control. Similar resentments can be seen in institutions in developed countries, when consultants make fleeting visits and advise people, for a large fee, on how to do their jobs. In Mozambique the problem was compounded by a history of Europeans treating Africa as a playground [9].

This problem extended to the directorate of the museum. Ostensibly they welcomed me and approved my projects; in practice, however, they frequently hampered my work. In one instance the museum director repeatedly organised meetings of all museum staff to clash with a workshop for the staff on handling works of art, the date and time of which I had previously arranged with her. On another occasion I was told by the museum's deputy director that I could not carry out any work unless accompanied by one of the museum's conservators, despite his being well aware that the conservators were often absent from the museum for most of the day. The conservators were not reprimanded for their absence and I was effectively prevented from working [10]. In a similar way, my efforts to lower RH in the museum were approved at a meeting chaired by the deputy director of the museum, but when the guards refused to participate there were no repercussions. My feeling was that the directorate aimed to 'put me in my place' by these means.

The impression that I was experimenting with the museum for my own amusement in a way which would be unacceptable in a museum in my home country was also a problem, and certainly a person with my experience would never have been given the kind of responsibility in a major museum in the UK which I assumed in the museum in Maputo. Developing countries are often expected to make do with solutions which would not be considered in the developed world and in this case, not only was the museum having to make do with me, as opposed to an experienced expert, but it was also having to make do with a cheap solution to climate control which would never be used in a museum in the developed world [11]. In many museums in the developed world air conditioning and humidifiers or dehumidifiers are used; installation of this type of unit, therefore, was desirable as it allowed the museum to assume equal status with other national museums of the world. Opening and shutting doors, even if it produced as good or better results, was demeaning to the museum's status.

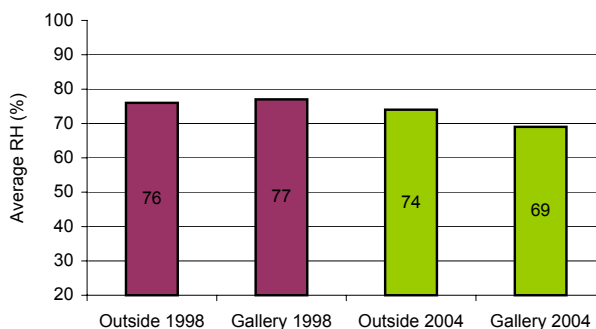


Figure 5. Chart showing average RH for the month of July

After the guards had been persuaded to participate, the recording of results from the hygrometers continued over four months. There were occasional missed readings, but I obtained a fairly complete data set for the hours between 7:30am and 6pm [12]. Data points for every half hour over the same time period in 1998 were taken to give an exact parallel with the new data. For the outside environment I had only morning and afternoon averages from the meteorological institute. However, since this applied both to the data for 1998 and the data for 2004, direct comparisons could be made, and it was possible to see whether the RH in the gallery in relation to that outside was affected by the opening and shutting of the doors.

The results showed that opening and shutting the doors caused the RH in the gallery to drop in relation to the outside RH by an average of 6% when compared with the figures for the same months in 1998 (fig. 5). Records showed that this drop, though small, would ensure that the RH in the galleries would be below 70% for at least half the year, ensuring that new paintings acquired by the museum would be less prone to sagging, cracking and flaking.

Running the same experiment in the basement store for a month, a similar drop was achieved; however, due to very high RH levels this would not be enough to have any beneficial effect on the paintings. Here I could only suggest applying a moisture barrier to the walls and floor and the installation of ceiling fans [13]. These measures would obviously incur initial costs, but would be relatively cheap and would require little subsequent maintenance.

The results of the experiment were presented to the museum's directorate, with the suggestion that the passive climate control regime be permanently incorporated into the museum's routine. It appeared that I had found a cheap and effective solution; sustainability, however, would depend

on the museum staff continuing the work after my departure.

Demonstrating the success of the experiment and thereby showing the importance of climate control to the staff was very difficult, since climate control does not produce instantly visible results. Graphs and tables were shown to the directorate, but staff lower down the hierarchy, who would be enacting the regime, had often received almost no education as a result of wars and poverty and so were unable to interpret the diagrams. In view of this, it was essential for the sustainability of the system that the directorate assigned duties to staff to keep it running. However, my position as an outsider, the directorate's opinion of the museum's conservation staff and the active systems in place in major museums in the developed world made it difficult to persuade them to act. As I left the museum in September 2004 I felt that the system would not be sustainable.

In fact, three years later, the doors of the museum are now kept more or less closed during the mornings. Although the system is not strictly observed, in view of the many difficulties encountered in setting it up and the fact that the doors had been left wide open throughout the day for many years previously, I count this a success. In many ways I should not have been surprised. Although the museum staff were suspicious of me as an outsider and may have wanted to demonstrate their independence from colonial powers by asserting themselves over me, they were nevertheless trained professionals who had the best interests of the museum at heart. In retrospect, their willingness to consider and implement my suggestions seems to show both dedication and maturity.

Discussions with conservators who have extensive experience of preventive conservation work in developing countries have revealed that the difficulties which I encountered are not confined to Mozambique [14]. I therefore offer a summary of the main considerations, in my experience, for creating sustainability in climate control projects in developing countries.

- (i) Money  
Initial costs are not so much the problem as continuing maintenance costs.
- (ii) Simplicity  
It is essential that non-specialists can understand and implement the system, and that it harmonises with already established routines.

- (iii) Staff support  
Establishing good relations with permanent staff and involving them in the project from the outset will help to keep a project running.
- (iv) Awareness of conservation  
It is particularly difficult to promote preventive conservation because it has no immediately visible outcome. However, it is important that at least the people at the top of the hierarchy understand its importance, as they can incorporate conservation strategies into the job descriptions of other staff.
- (v) Setting an example  
You cannot expect staff to go out of their way to keep a project running if you yourself are not seen to be willing to carry out the day-to-day tasks involved. Similarly, institutions in the developing world will always feel that they are having to make do with second-best solutions if institutions in the developed world prefer expensive solutions to innovative ones where climate control is concerned.
- (vi) Time  
It takes a long time to foster trust, understanding and support in people who have very little previous experience of conservation. I felt that six months was a shamefully short time to spend implementing a project of this kind. However, I have since discovered that most projects which involve an outside expert visiting a developing country are considerably shorter. Establishing a routine over time will give a much better chance of sustainability than issuing instructions and then leaving.

Many of the problems discussed above are being addressed. The PREMA project in Africa has raised awareness of conservation amongst museum professionals on that continent [15], and permanent institutions which will continue this work are beginning to appear [16]. The internet can also be used to provide information, instruction and support to conservators working in developing countries. In the developed world, conservators are re-thinking attitudes to climate control, and in many cases passive means are being chosen over active, partly due to financial considerations or the restraints imposed by the structure of historic buildings, but also in response to concerns about the environment [17]. If this trend continues, institutions in the developing world will be able to feel that, far from putting up with second best solutions, they have piloted improved solutions to sustainable climate control in the developed world.

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## REFERENCES AND NOTES

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- 2 The founding of the museum and the political issues involved in deciding which paintings should be included in the collection and displayed are described in Cossa G. 2001. *O Desenvolvimento do Museu Nacional de Arte e a Problemática da Preservação do Nosso Legado Cultural*. In *V Encontro de Museus de Países e Comunidades de Língua Portuguesa Maputo 2000*. International Council for Museums, Lisbon, pp 59-65.
- 3 Claire Gerhard's experiences in Mozambique are published as: Gerhard C. 1999. *Let's Work on This: An American Conservator in Mozambique*. In R Rushfield and M Ballard, eds. *The Materials, Technology and Art of Conservation. Studies in Honor of Lawrence J. Majewski on the Occasion of his 80th Birthday*. New York University: Institute of Fine Arts, Conservation Center, pp 300-10.
- 4 Pearson, Daniel and colleagues have published widely on the dangers of HVAC. King, Daniel and Pearson found that in the Djomi Museum in the Australian tropics, when domestic quality air conditioning was operating, the humidity was high enough for mould growth,

whereas with no control the environment in the building was considerably better. King S, Daniel V and Pearson C. 2000. *Airconditioning Small Tropical Museums: A Technical Note*. In *AICCM Bulletin* December 2000, pp 33-36. Similar problems with air conditioning are reported in Daniel V, Pearson C, Cole I, Ganther W & King S. 2000. *Behaviour of Museum Buildings in Tropical Climates*. In *Tradition and Innovation: Advances in Conservation. Contributions to the Melbourne Congress*. 10-14 October 2000. IIC, pp. 45-50, and more recently in Daniel V, King, S, Pearson C & Cole I. 2005. *Stories From Historic Buildings*. In *ICOM Committee for Conservation 13th Triennial Meeting Preprints*, vol. 1, pp. 625-629.

- 5 The air conditioning units were from Oriima and the dehumidifiers from Westpoint.
- 6 Similar concerns about air conditioning in museums in the developed world are discussed in Oreszczyn T, Cassar M and Fernandez K. 1994. *Comparative Study of Air-Conditioned and Non Air-Conditioned Museums*. In: *Preventive Conservation Practice Theory and Research*. IIC, pp. 144-148.
- 7 A discussion of the problems encountered by people from developing countries trained as conservators abroad and returning to their home countries to find themselves unable to work is found in Pearson C. 1996. *Conservation Training for Developing Countries: The Hopes and Realities*. In *ICOM Committee for Conservation 11th Triennial Meeting Preprints*, vol. 1, pp 122-127.
- 8 Maekawa and Toledo describe a system working on similar principles but using humidistatically controlled ventilators and heaters. This avoids problems with creating extra work for staff, improving sustainability in one way, but requires a continuous supply of electricity, so reducing sustainability in another way. Maekawa S & Toledo F. 2002. *Controlled Ventilation and Heating to Preserve Collections in Historic Buildings in Hot and Humid Regions*. In *ICOM Committee for Conservation 12th Triennial Meeting Preprints*, vol. 1, pp. 58-65.
- 9 It has been suggested to me that sexism was the problem; however, in Maputo there is gender equality in the workplace and many of the senior staff at the museum, including the director, were women. Nepotism has been identified as a problem in many developing countries, putting people into jobs who are not interested in doing them but who cannot be

sacked for poor performance; however, this did not appear to be a problem at the museum in Mozambique, where the senior staff were all well qualified for their jobs. Low pay was a factor in the guards' reluctance to help me; like many foreigners working in Mozambique, I was on a generous grant while they were on pitifully small local salaries, a situation which compounded their resentment towards me.

- 10 Low pay was the problem here. Absence of staff was tolerated as many were busy with second jobs to supplement their tiny incomes - one of the conservators spent time producing bus destination signs using the computer and printing facilities at the museum.
- 11 The 'donation' of out-of-date drugs to developing countries is an example of the phenomenon from another sector.
- 12 The use of dataloggers to give complete and accurate readings of the environment was suggested to me. These are relatively cheap but would still have represented a very significant outlay for the conservation department at the museum. Part of my aim was to persuade the museum's conservators that effective conservation work could be carried out using the resources already available to them, since they were paralysed into inaction by the idea that all conservation work requires money. For this reason I wanted to stick to using the museum's equipment rather than buying or borrowing dataloggers from elsewhere.
- 13 Colleagues in Durban suggested the paint used for road markings as a cheap and effective moisture barrier. This solution needs further investigation.
- 14 Gael de Guichen (ICCRUM) and John Dean (Cornell University), amongst others, have been very helpful in discussing the topics covered in this paper with me.
- 15 Barclay R L & Antomarchi C. 1994. PREMA: A Conservation Strategy for African Museums. In Preventive Conservation: Practice, Theory and Research. IIC, pp. 61-64.
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