UFMG
UNIVERSIDADE FEDERAL DE MINAS GERAIS
PROEX / PAIE

Cultural Heritage Agency
Ministry of Education, Culture and Science

Casa da Glória

Instituto de Geociências - UFMG
Diamantina - MG

LACICOR
Laboratório de Ciência da Conservação - CECOR -EBA / UFMG

UFMG BELAS ARTES

cecor

International Workshop

Managing Indoor Climate Risks

Towards a sustainable conservation of mutual cultural heritage in Brazil

Diamantina – Minas Gerais – Brazil

October 29th – November 6th, 2016

www.lacicor.eba.ufmg.br

CASE STUDIES / SHORT PAPERS

Workshop team

Netherlands

dr Bart Ankersmit
Senior Researcher | Research
Rijksdienst voor het Cultureel Erfgoed | Cultural Heritage Agency
Smallepad 5 | 3811 MG Amersfoort
Postbus 1600 | 3800 BP Amersfoort
T 0031(0)33 – 421 7421
Visiting adress
Hobbemastraat 22 | 1070 CZ | Amsterdam
Postbus 76709 | 1070 KA | Amsterdam
T 0031(0)20 3054 737
F 020 3054 600
b.ankersmit@cultureelerfgoed.nl
www.icn.nl & www.cultureelerfgoed.nl

Ir. Marc Stappers
ir. M.H.L. (Marc) Stappers
Medior-specialist Bouwfysica / Researcher | Research
Rijksdienst voor het Cultureel Erfgoed | Cultural Heritage Agency
Smallepad 5 | 3811 MG | Amersfoort | kamernummer 3.10
Postbus 1600 | 3800 BP | Amersfoort
T 0031(0)33 421 74 27
F 033 421 77 99
m.stappers@cultureelerfgoed.nl
www.cultureelerfgoed.nl

Dr. W. (Bill) Wei
Senior Onderzoeker / Senior conservation scientist
Rijksdienst voor het Cultureel Erfgoed
Snail-mail:
Postbus / P.O. Box 1600
NL-3800 BP Amersfoort
The Netherlands
Bezoekadres / Visitor's address
Courier:
Hobbemastraat 22
NL-1071 ZCAmsterdam
Tel. +31 33 421 7183
Mob. +31 6 5273 2101
b.wei@cultureelerfgoed.nl

Brazil

Prof. Dr. Luiz A C Souza
Associate Professor
LACICOR - Conservation Science Laboratory
CECOR - Center for Conservation and Restoration of Cultural Heritage
School of Fine Arts - Federal University of Minas Gerais
Av. Antonio Carlos, 6627 - Belo Horizonte - 31270-901 - MG - Brazil
New - Telephone, Whatsapp: + 55 31 987571969
luiz.ac.souza@gmail.com
www.lacicor.eba.ufmg.br

Prof. Dr. Willi de Barros Gonçalves
CECOR – Centro de Conservação Restauração de Bens Culturais
LACICOR – Laboratório de Ciência da Conservação
Escola de Belas Artes - UFMG
Av. Antonio Carlos, 6627
CEP 31270-901 Belo Horizonte - MG
tel. 55-31-3409-5378
willidebarros@ufmg.br

Bolsistas:
Christiane S.G. Santos – Museóloga – Mestranda em Artes EBA-UFMG
christianegsantos@gmail.com
tel. 55-91-980881651

Bianca C.R. Vicente – Museóloga - Mestranda em Artes EBA-UFMG
biancacristinarv@gmail.com
tel. 55-91-984405732

FEATHERWORK CONSERVATION AT THE ETHNOGRAPHIC COLLECTION OF THE MUSEU PARAENSE EMILIO GOELDI

Author – Bianca Cristina Ribeiro Vicente – Master's degree student at the School of Fine Arts of the Federal University of Minas Gerais

Abstract:

This paper describe the initial phase of a research about indigenous featherwork conservation with emphasis on the case of Curt Nimuendaju Storage Room which belongs to the Museu Paraense Emilio Goeldi. The feather is a sensitive material, but there is not much information about its reactions at incorrect temperature and relative humidity. At this work will be highlighted the principals forms of featherwork degradation and the specificities of this particular Storage Room.
Keywords: Featherwork; Conservation; Storage Room

Introduction

The indigenous featherwork is one of the most important brazilian cultural heritage. This is mentioned since de first document made about Brazil, the Pero Vaz de Caminha's letter, written in 1500 to announce and describe the new land and the people who were here (BILBAO, 2002). Since then the indigenous featherwork has been part of ethnographic collections all over the world, specially after the 18th and 19th centurys with European travelers (THOMPSON, 2015).

In the 19th century, after the royal family came to Brazil, the scientific institutions began to emerge in the country and with them museums, being the main ones focused on Natural History and Anthropology. The particular case that we are studing are the pieces safeguarded at the Ethnographic Storage Room of the Museu Paraense Emilio Goeldi, one of the oldest scientific institutions from the north of Brazil, having begun in 1866 from an Association formed by important people of Belém at that time, as Domingo Ferreira Penna (SANJAD, 2010; SCHWARCZ, 2013).

Nowadays, the Ethnographic collection of this important museum has almost 15.000 objects. Most of them are from indigenous groups, but there are also african pieces and others regional groups. To better preserve this collection, it was implanted at 2003 a alternative system that uses blows fans,

exhaust fans and dehumidifiers to maintain the relative humidity controlled and bellow 70%. This aims to avoid the presence of biodegradation agents, considered the most dangerous for this collection.

Unfortunately, after three years the monitoring of the climate conditions has no longer occurred and never happened a monitoring of the conservation conditions of the pieces after that. So this research aims to understand the conservation conditions of a important part of this collection, the featherwork, and the effects of the climate at this.

Brazilian heritage: indigenous featherwork and its importance

The featherwork can be described as the ensemble of techniques designed to manufacture artifacts with feathers as feedstock (MOTTA, 2006, p. 102). Most of Brazilian authors, as Berta Ribeiro (1988), consider this work as an art and adds the aesthetic and stylistic components to define the featherwork. In Brazil there are a lot of indigenous groups that produzes this pieces, but their styles are the most diverse as possible because of its diferents techniques, feathers, customs, uses, among other factors.

However, there are two diferent linguistic groups best known for the featherwork art, one of them is the Tupi, famous because of the Tupinambás, but also have the Mundurucus and the Kaapor, and the last one is known for the precious use of minimum feathers composing beautiful details (RIBEIRO; RIBEIRO, 1957). The other group is the Macro-Jê where we can find the Karajá, Bororo, Kayapó and others that produces marvelous pieces with big structures and feathers making a kind of scenographic effect (RIBEIRO, 1989).

This typology of collection must be studied and preserved for its importance. A lot of the groups that used to produces this in the past do not exist anymore or do not currently produce the same way as in the past. Therefore, to keep the traditional knowledge and this important indigenous heritage, many Brazilian museums with an emphasis on natural history and ethnography have been dedicated to gathering, exhibiting and preserving these materials. However, specific studies on featherwork conservation in Brazil are still incipient with rare academic publications regarding research in the area.

The feather: structure and needs

Feather, feedstock for the featherwork, is composed mainly of keratin (about 91%), water and lipids.

There are different types of feather that can be found in the birds and, consequently in the featherwork. Each type is intended for a particular function and location of the animal. The variety can be separated in remiges and rectrices (flight feathers); contour feathers; semiplumes; down

feathers; filoplumes and bristles (HUDON, 2005). The contour and down feathers are the most commonly used in artifacts (BISHOP MUSEUM, 1996), but the flight feathers are also very used at the Brazilian indigenous production.

This material is extremely sensitive and its principals degradation occur by light, dust, mechanical damage, biodegradation agents and incorrect temperature and relative humidity. Light damage is very known for cause fading of the feather colors depending on its sensitivities; "in a featherwork the most sensitive feather will define the light sensitivity of the whole item" (RIEDLER et al. 2014, p.44). Mechanical abrasions, are also a very common way to cause damage on objetcs from museums (BRADLEY, 2011), feathers has a delicate structure with fine barbs and barbules that can easily break and it harm the structural colors of the object.

Other cause of damage is the dust, which for feathers is even more complicated to control because of the oil present in the material since when the bird is alive; this harms not just the aesthetics, but can accelerate the chemical reactions. And a very worrying thing is the biodegradation agents attracted mainly by the sulfur present on the keratin, principal protein of feathers, so that cause the presence of mould,bacteria and insects if there isn't a controlled environment (BISHOP MUSEUM, 1996; BLYSKAL, 2009).

But at this research our focus is about the damage that can be caused by the temperature and relative humidity. This is not a theme studied hard and, even some authors do given ideal parameters as 60ºF-75ºF (about 15,5°C - 23,8°C) for temperature and 45% - 55% for relative humidity (BISHOP MUSEUM, 1996), we are still searching for methods of analysis to understand how the feather can react and if it can be degrade for been exposed so long at the conditions presents at the Curt Nimuendajú Storage Room.

The Curt Nimuendajú Storage Room

The city of Belém, has a climate that can be characterized as hot and humid. There are two different seasons that can be identified: the rainy season that goes between December and May, and the dry season from June to November. At the period of 1967 to 1996 the averages of temperature are 26,4ºC and 84% for relative humidity (BASTOS et al. 2002). The principal characteristic from there are the high temperatures and humidity.

At this scenario are the Museu Paraense Emilio Goeldi and its collections. In the past the ethnographic collection was placed at the zoobotanical park of this institution, safeguarded at two rooms with the climatization made by ar conditioning. In 2003, the Storage Room was moved to the Research Campus of the museum to a new building made to receive the collection. At this new place

was implanted a alternative system for acclimatization with a project from the Getty Conservation Institute.

This project aimed avoid the occurence of biological attacks, considered major risk factor for such typology of collection, so the quimical and mechanical deterioration are not considered for the system. Besides that, the system was designed to integrates low cost, be robust and easy maintenance. Therefore, this system consists on two ducts with two supply fans and two ducts with four exhaust fans and four dehumidifiers. All the system works on the command of sensors located inside and outside of the building. Basically "the ventilators were to operate when the outside relative humidity was lower than the value to remove moisture, and the dehumidifiers were to activate when the outside relative humidity was higher than 70%." (MAEKAWA; TOLEDO, 2010, p.3).

The system was monitored for three years (2003-2005) after its implantation, with results corresponding to the expected with averages for relative humidity between 65-70%. Unfortunately, after this time there was no monitoring for almost ten years . However, since 2015, the technical staff of the Storage Room has continuously monitored the environment with data loggers. And for this research, there were instaled quatro dataloggers T&D RTR-5W and four ONSET HOBO U-10 that will monitoring the envioronment for one year (July, 2016- July, 2017) inside and outside of the building.

However, there is a even greater gap with respect the behavior of the pieces in this new environment. There wasn't a systematic monitoring of the conservation conditions of the objects, therefore, a more detailed survey of the documentation and the history of such pieces must be observed, as well as a diagnosis about the current reality of the materials with focus on feathers.

Interlinking the history, the currenty condition of the acclimatization and the state of conservation of the pieces, this research can help to think about preservation measures for this collection and specifically for this type of material.

Final considerations

This research is still in the initial phase with the search of bibliographic references and also the search for more adequate methodologies to analyze the state of featherwork conservation considering the possibles changes caused by the current acclimatization system. We can already understand that this material is extremely susceptible to deterioration factors and can easily suffer damages. Therefore, although incipient we understand that this study is of fundamental importance given the low Brazilian production in the area of feather conservation and the importance of preserving this Brazilian indigenous heritage.

References

BASTOS, Therezinha; PACHECO, Nilza; NECHET, Dimitre; Sá, Tatiana. **Aspectos climáticos de Belém nos últimos cem anos**. Belém: Embrapa Amazônia Oriental, 2002.

BILBAO, Fernando Martínez de Alegria. **Plumaria Amazónica**. Museo Nacional de Antropología. Madrid: Ministerio de Educación, Cultura y Deporte. 2002.

BISHOP Museum. **The care of Feathers**. USA, 1996

BLYSKAL, Barbara. Fungi utilizing keratinous substrates. **International Bideterioration and Biodegradation**. N. 63. 2009. p. 631-653.

BRADLEY, Susan M. Os objetos têm vida finita? In: MENDES, Marylka et al. (org.) **Conservação: conceitos e práticas**. 2 ed. Rio de Janeiro: Editora UFRJ, 2011.

HUDON, Jocelyn. **Considerations in the Conservation of feathers and hair, particularly their pigments.** CAC/ACCR 31st Annual Conference, Jasper. 2005.

MAEKAWA, Shin; TOLEDO, Franciza. A collection climate control system for an ethnographic storage room of a museum in the north of Brazil. In: ASHAE Transactions, Vol. 116. 2010.

MOTTA, Dilza Fonseca da. **Tesauro de cultura material dos índios no Brasil**. Rio de Janeiro: Museu do Índio, 2006.

RIBEIRO, Berta G. **Arte indígena, linguagem visual/Indigenous art, visual language**. Trad. Regina Junqueira. Belo Horizonte: Itatiaia; São Paulo: Ed. da Universidade de São Paulo, 1989.

_____. **Dicionário do artesanato indígena**. Ilustrações: Hamilton Botelho Malhano. Belo Horizonte: Itatiaia; São Paulo: Editora da Universidade de São Paulo, 1988.

RIBEIRO, Darcy; RIBEIRO, Berta G. **Arte Plumária dos Índios Kaapor**. Rio de Janeiro, 1957.

RIEDLER, Renée; PESME, Christel; DRUZIK, James; GLEESON, Molly; PEARLSTEIN, Ellen. A review of color-producing mechanisms in feather and their influence on preventive conservation strategies. In: **Journal of the American Institute Conservation**. Vol 53 n. 1. 2014. P. 44-65.

SANJAD, Nelson. **A Coruja de Minerva: o Museu Paraense entre o Império e a República (1866-1907)**. Brasília: Instituto Brasileiro de Museus; Belém: Museu Paraense Emilio Goeldi; Rio de Janeiro: Fundação Oswaldo Cruz, 2010.

SCHWARCZ, Lilia K. M. A "Era dos Museus de Etnografia" no Brasil: o Museu Paulista, o Museu Nacional e o Museu Paraense em finais do século XIX. In: FIGUEIREDO, Betânia; VIDAL, Diana (orgs.). **Museus**: dos gabinetes de curiosidades à museologia moderna. 2 ed. Belo Horizonte: Fino Traço, 2013.

THOMPSON, Analucia. A coleção etnográfica da Missão Austríaca (1817-1835). In: GUIMARAENS, Cêça; RANGEL, Vera; BERTOTTO, Márcia. **Museologia Social e Cultura**. Rio de Janeiro: Rio Books, 2005.

COLEÇÃO DE ARTE DA CIDADE – CENTRO CULTURAL SÃO PAULO

Camila Bôrtolo Romano – Coordinator of Coleção de Arte da Cidade

Abstract:

The Coleção de Arte da Cidade is on guard of Centro Cultural São Paulo (CCSP) and the Division of Collection, Documentation and Conservation make its management. This Collection has around 8.000 items and has a basic way to climate control in storage. This case study addresses the concerns about the storage conditions, showroom and how this conditions can affect the collection.

Keywords: Storage, Showroom, climate control

Introduction

The Centro Cultural São Paulo is a public space, managed by Secretaria Municipal de Cultura. It was created in 1982, being considered the first multidisciplinary space of culture in the country. The building is in Sao Paulo / Brazil, next to a Subway Station and has 46.500 m² distributed in 4 floors.
The space of CCSP allows users to live together (to study, to dance, to rest) and appreciate diverse cultural programming (cinema, theater, exhibitions). Besides cultural programming and set of libraries, the CCSP has on its guard 5 collections that are managed by the Division of Collection, Documentation and Conservation, are they: Coleção de Arte da Cidade, Arquivo Multimeios, Discoteca Oneyda Alvarenga, Missão de Pesquisas Folclóricas and Núcleo Memória.

Representing the Coleção de Arte da Cidade at International Workshop of Managing indoor climate risks, I present the following information: The Coleção de Arte da Cidade was created in 1962 with intention of gather, list and preserve the works of art scattered around the city of Sao Paulo. Currently the collection has around 8.000 items including: Drawings, engravings, sculptures, paintings, installation, mail art, artist books, among others. We can say that 80% of collection is made of paper.

The storage has 260 m² divided in 4 rooms. It is located in the basement, without windows and the walls are made of brick. We consider a good location because it doesn't have much interference from the external climate, thus facilitating better climate control inside the room, even without air conditioning.

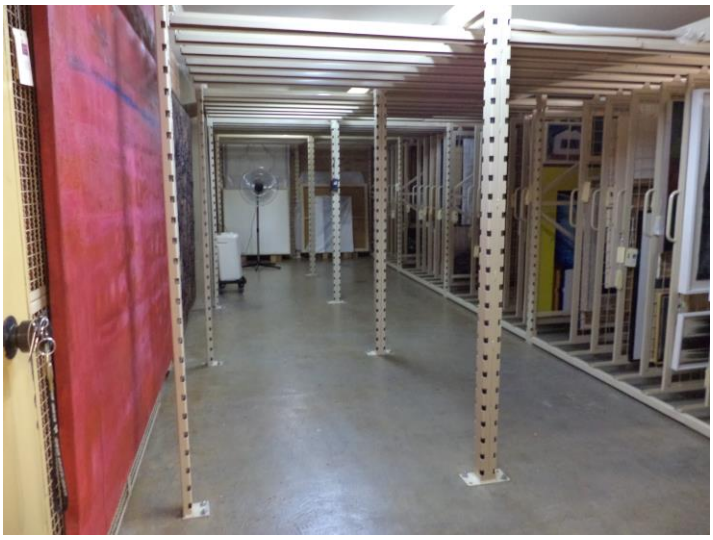

Figure 1 – Storage of Coleção de Arte da Cidade

To climate control of storage, is used fans to promote air circulation and dehumidifiers to control de relative humidity (RH). The Temperature and Humidity data are collected by the Thermo hygrometer manually, for at least three moments during the day, at the opening of the storage, during cleaning and at the time of its closing. This information is written down on paper and then passed to a worksheet on the computer.

Based on our measurements it was possible to determine that the average indoor climate of the storage is 22 °C of temperature and 61% of humidity throughout the year. And the average external climate is 24°C temperature and 73% humidity throughout the year.

The following concerns were presented at the workshop: Some employees need to work within the storage every day, so for better air circulation the door is kept open throughout the day, but the pollution is very large due to the location of the CCSP. So the problem was how would it be possible to promote air circulation without having problems with temperature variations, but without the need to install an air conditioner? Because it is a public institution, the CCSP would not be able to carry out the necessary maintenance in an air conditioning, putting the collection at greater risk in a situation in which the equipment stopped working.

With this concern in mind throughout the workshop it was possible to realize that there was so much concern about possible climatic variations, a fact that we have no measured evidence, that we did not realize that in fact, the team does not observe any visible damage to the collection, As for example appearance of mold, insects, oxidation or other damages. Thus, about the climate there is no problem to solve, it would only be advisable to install a Datalogger to record in a shorter time the data of temperature and humidity for a more consistent analysis.

With this, we conclude that the biggest problem in the storage is the entrance of pollution next to the collection. It is advisable to do the measurement of pollutants inside the reserve, but even without having made a measurement with an equipment, we observe a fast accumulation of dust on the furniture and on the surface of the works of art that don't have packaging, for example the paintings fixed in the walls.

We attribute to this situation the pollution of the region as the main cause of damage to the collection in the storages. As a solution strategy, we recommend installing a filter hood in the rooms to promote air circulation even with the door closed, thus preventing the entry of pollutant particles into the storage.

Different from the conditions of the storage already presented, the CCSP showroom, used for the most part to exhibit works from the collection, showed visible damages to works along exhibitions, such as ripples In paper works. This drew attention to the climatic conditions inside the showroom.
The exhibition room is located on the 4th floor of the CCSP, has 585 m², is made of concrete and glass (between internal and external) and has a basic air conditioning system. Despite having an air conditioning system there is no temperature and humidity control in the room. Measurements have never been carried out to prove the cause of the damage to the works of the collection.

For this situation, it would be advisable to install a datalogger to measure the temperature and humidity data. After analyzing the data, a strategy for adjusting the climate of the exhibition room in a manner similar to that of the storage should be developed. In case the data indicate high humidity variations, for example, the placement of dehumidifiers in the environment would be indicated.

Final considerations

The concern of the CCSP technical team was so much about the storage that we did not realize that the biggest risk factor to the collection would be the climatic conditions of the exhibition room. In this way I conclude that the methodology presented by the Cultural Heritage Agency of the Netherlands has proved very useful in its application because it is very objective and provides a more sustainable vision for mitigation strategies. The Centro Cultural São Paulo has 5 collections under its guard, this methodology will bring many benefits for the management of these collections, since through the measurement of data, application of graphics, the level of each problem of risk to the collections and analysis will be more visible To indicate the most sustainable solution to be applied. It also makes it more efficient to present mitigation proposals to the Directors who are responsible for the final approval decision.

References

CENTRO CULTURAL SÃO PAULO. **A Pinacoteca do Município de São Paulo:** Coleção de Arte da Cidade: catálogo. São Paulo: Banco Safra, 2005.

SERAPIÃO, Fernando. **Centro Cultural São Paulo:** Espaço e vida. São Paulo: Editora Monolito, 2012.

THE CONSERVATION OF FIBRES IN THE STORAGE ROOM CURT NIMUENDAJÚ OF EMÍLIO GOELDI STATE OF PARA MUSEUM

Christiane Sofhia Godinho Santos – Master degree Student at Arts Post Graduation studies from UFMG[1]

Abstract:

The storage room of Curt Nimuendajú of Emilio Goeldi State of Para Museum (MPEG[2]) is formed mainly by fibres which because their composition, may suffer the environmental factors effects. It is important to perform chemical and physical analysis that may allow the understanding of the fibres decay state and how they have been adapted to the environment where they are as well as how such environment has affected or not the physical residing of those samples.

Keywords: fibre; conservation; environment.

Introduction

In the amazon region, in XIX century, the Emilio Goeldi State of Para Museum had already been stablishing a connection between the knowledge acquired in the region and the resident community, making researches, safeguard of heritages, education projects and publicizing works. The museum had been formed by the end of nineteenth century from Philomatic Society[3], which was the previous of the current Emilio Goeldi State of Para Museum. That institution was stablished in the capital city of state of Pará, Belém, Brazilian Amazon region, on the shores of Guajará and Guamá rivers bay (Figure 1), with around 719 km² and 12 m medium (BASTOS et al., 2002). That area is exposed to a tropical climate with high temperatures and relative humidity of air the whole year (SOUZA JUNIOR *et al.*, 2009) presenting humidity levels above 80% and medium temperature around 26°C (OLIVEIRA et. al., 2010).

[1] Universidade Federal de Minas Gerais in Portuguese: Federal University of State of Minas Gerais
[2] Museu Paraense Emilio Goeli in Portuguese
[3] Sociedade Filomática in Portuguese

Figure 1 City of Belém, State of Pará, showing the position of Guajará and Guamá rivers around the city. Image from Google Maps.

Such institution stablishes its activities with activities as coted before and it counts currently with three sites: Zoo botanic Park at Magalhaes Barata Avenue; the research *campus* at Perimetral Avenue (Terra Firme zone) and the Ferreira Penna Scientific Station in Caxiuanã city. Nowadays that institution is bound to the Science and technology Ministry (SANJAD, 2008), distributed in four coordination settled like: Botanic at Research *Campus* at Perimetral avenue; Human Sciences; Earth Sciences and Ecology and Ecology – responsible for researching, studies and preservation of all scientific heritages. It is in the Human Sciences Coordination where the *Curt Nimuendajú* ethnographical storage room is found.

Since its creation, The MPEG has jointed ethnographical objects important to several region studies compounding an initially simple group with around 300 pieces. Such heritage combines artefacts distributed in a heterogenic geographical way with sections from Brazil, Africa, Peru and Surinam (ARNAUD, 1981) with make nowadays a storage room with over 13.000 pieces (MOURA, 2001) protected by the National Historic and Artistic Heritage Institute (IPHAN) under the tag of "Archaeological, ethnographical and environmental heritage" (BENCHIMOL, 2009).

Accorging to Moura (2001) the materials in the heritage are distributed among:

> "adornos e objetos de usos pessoais, lúdicos, rituais, mágicos e de implementos e utensílios ligados às atividades de subsistência, confortos domésticos e pessoais, que englobam as mais variadas categoIias funcionais, técnicas, matérias-primas orgânicas (animal/vegetal) e inorgânicas (metal, rocha, miçanga industrializada, vidro, fibra sintética), motivos decorativos (geometrizante, naturalista)" (p. 546)

A significant part of the samples of native manufacture that form the *Curt Nimuendajú* storage room are composed by or have in them fibres. Such objects made by vegetal materials are considered, according to Vethem (2007) as one of the oldest technologies of Humanity due to the malleability, utility and easiness of renewing, inserted in the life of the villages of the recipient to store small objects even in the transport and processing of food needed to the people's day life.

Such samples, as other cellulose (C6H12O6) base compounds are subject to decay due to environmental factors, mainly because they are hygroscopic. That condition may ease the mechanical decay process causing cracking and weakening the material and the happen mainly due to changes in temperature and humidity.

Because of Belém´s weather, and considering the organic composition of the objects, it was put in place in the *Curt Nimuendajú* storage room in 2003 a control system of climate control to cultural institutions in regions with high temperature and humidity, developed by Getty Institute of Conservation (GCI[4]) that foresee an alternative air conditioning system: "the method integrates the use of ventilation and heating and dehumidification to reduce conditions of extreme humidity inside the building" (MAEKAWA, 2007, p. 227). That system is widely spread in literature to storage rooms in tropical countries.

This system consists of two blowers fans located in the external area of the building that lay filtered air inside the storage through two central ducts in the ceiling of the safeguard area. After spread through the environment, the air is drawn through two ducts positioned on the side walls that are connect with exhaust fans in the outdoor area. Relative humidity is also regulated with the aid of four dehumidifiers (Idem). Such a system is designed to keep the RH below 70%. Currently, the maximum value for the system is 60% RH.

However, according to the authors themselves, the most worrying factor to the responsible people of the storage room was the bio decay that could affect the samples – and indeed such proposal showed to be beneficial considering the biological attacks – without considering the chemical aging and mechanical damages as treats to the heritage. As over

[4] Instituto Getty de Conservação in Portuguese

10 years has already passed fewer analysis treat of the chemical and mechanical behaviour of the objects subject of such acclimatization system.

Due to the relevance of such samples to the Amazon region and considering that the ethnographical objects, which are in the museum context, have as the greater challenge the preservation because assorted in a collection not all of them have the same possibilities of preservation, considering the diversity of their compositions; some are long-lasting and some other suffers with a faster degradation (VELTHEM, 2012). There is the need of frequent chemical and physical analysis that allow to understand the decay of the fibres and in the future, the understanding of how they have been adequate to the environment in which they are as well as the environment itself can or cannot affect the very physical existence of those samples.

In March 2016 it has begun a the master project approved in the Graduate Program in Arts of the Faculty of Fine Arts of UFMG was started, which seeks to identify and characterize composite or fiber elements in their structure that integrate the ethnographic collection of MPEG, turning first the collection of the researcher Curt Nimuendajú, who was of great relevance for the formation of this storage room, qualifying the hygroscopic behavior of these specimens considering the air conditioning that is subject in the storage room.

Methodologically some steps will be followed, such as the identification of the material through the use of Optical Microscopy - some fibers present in the MPEG collection already have defined composition, however, there is no general overview of all the materials used in the composition of the copies of the collection -, determination of hygroscopic behavior and environmental monitoring to record changes in relative humidity (UH) and temperature (T) within the storage room in the period of one year.

Given the prematurity of the project, there are still no results that can answer the questions of the physical and chemical state of the objects in fiber or even how they have been affected given the environment in which they are. In progress, environmental monitoring has taken place with the use of dataloggers - four RTR-5W T & D models with wireless access and four ONSET - HOBO U10 devices arranged together with the other models to be used as backup in case of mechanical failure - distributed within the ethnography storage room and externally in the building.

The longevity of a museum item depends greatly of the environment conditions to those they are exposed (MAEKAWA, 2007) in and out the storage room and, according to

Cheung (2008) the external climate conditions to a museum heritage are going to impact the climate inside the building to the point of contributing to a fasten decay of the goods.

Final considerations

The ethnographical collections are important sources of study, mainly to the human's studies since it is very relevant to get to know the factors that might accelerate the decay process of such museum goods considering the material composition and the environment where they are safeguarded. The samples in fibres of the *Curt Nimuendajú* storage room as fundamental elements to the study of the resident populations in North region of Brazil, and they shall contribute to the study of the decay process in those materials as well shall allow the understanding of how the alternative system used by MPEG has been influencing on the remaining of such storage room samples.

References

Arnaud, E. (1981). Os estudos de Antropologia no Museu Emílio Goeldi. Acta Amazônica, 11, 137-48.

Bastos, T. X., Pacheco, N. A., Nechet, D. & Sá, T. D. A. (2002). Aspectos Climáticos de Belém nos Últimos Cem Anos. Belém: Embrapa Amazônia Oriental.

Benchimol, A. C. Informação e Objeto etnográfico: percurso interdisciplinar no Museu Paraense Emilio Goeldi. 2009. (Masters thesis). Instituto Brasileiro de Informação em Ciência e Tecnologia. Rio de Janeiro.

Maekawa, S. (2007). Estratégias alternativas de controle climático para instituições culturais em regiões quentes e úmidas. In J. N. Bittencourt, S. F. Benchetrit & M. Granato (pp. 223-244). Rio de Janeiro, RJ: Museu Histórico Nacional.

Moura, R. T. (2001). Levantamento e descrição de artefatos indígenas relacionados à pesca do acervo da reserva técnica Curt Nimuendajú. Boletim do Museu Paraense Emílio Goeldi Antropologia, 17.

Oliveira, M. C. F. [et al.] 1998. Influência da temperatura e umidade do ar na cidade de Belém PA. Brasília: Congresso Brasileiro de Meteorologia.

Sanjad, N. (2005) A Coruja de Minerva: o Museu Paraense entre o Império e a República, 1866-1907. 2005. (Doctoral dissertation). Casa de Oswaldo Cruz/FIOCRUZ, Rio de Janeiro, BR.

Souza Junior, J. A., Nechet, D., Oliveira, M. C. F. & Albuquerque, M. F. (2009). Estudo do comportamento da temperatura e precipitação nos períodos chuvosos e menos chuvosos em Belém-PA em anos de fortes eventos de El Niño e La Niña. Revista Brasileira de Climatologia, 5, 87-101.

Velthem, L. H. V. (2012, January-April). O objeto etnográfico é irredutível? Pistas sobre novos sentidos análises. Boletim do Museu Paraense Emílio Goeldi – Ciências Humanas, 7(1), 51-66.

CLIMATOLOGY AND DECISION-MAKING

Eduardo Ferreira Moura – BA in Psychology

Abstract:

This paper discusses a methodology based on climatology to assist in the process of decision-making in conservation and restoration of cultural heritage on paper.

Keywords: cellulose degradation, decision-making process, thought experiment

Introduction

The end of prehistory begins with writing. Writing enabled the development of complex ideas. But until 1445 the books were copied by hand by scribes who could take over a year to produce a copy. The ideas spreads slowly. That was until the invention of the Gutenberg press, a printer that could copy multiple pages hundreds of times a day. With it until the end of the fifteenth century Europe printed more than 20 million copies of books. In the sixteenth century it was ten times more. And in the eighteenth century it was fifty times more, nearly a billion copies. With printed books ideas circulate much more; science became able to discuss their results globally and faster. And our data production had not yet begun, when compared to the amount of information we've been producing in digital media (Gleick, 2013).

Currently, about 1,000 new books are published every day around the world. The Biblioteca Nacional do Brasil (Brazil National Library) receives per day, the equivalent of a newsstand on paper. There are currently more than 100,000 scientific journals in the planet. A single copy of the New York Times contains more information than what an average person would receive throughout their lifetime 300 years ago.

The extension of the concept of heritage, combined with the speed which contemporary society produces data, requires Archives, Libraries and Museums to take increasingly tough decisions. Events such as the flooding of Venice and the acid paper crisis reinforce the need to think about making decisions from a perspective of efficient management of financial and human resources.

The reasons leading to the realization of conservation and restoration treatments are multiple, and do not depend only on the state of conservation, use and access to collections, but also the values assigned to them. The preservation activities likewise are numerous, including interdisciplinary performances and several judgments. (Hannesch, Granato, 2015).

The subjectivity involved in decision-making must have their boundaries on ethical and technical responsibility. What if it was possible to predict with mathematical precision the permanence in years of each of the cultural property of a collection on paper? Will that helps the decision-making process regarding the conservation and restoration practices to be adopted? This paper discusses a methodology based on climatology to assist in the process of decision-making in conservation and restoration of cultural heritage on paper.

Theoretical foundation

Porck (2000) and Figueiredo Junior (2014) describe three possible destinations in terms of degradation of cellulose, and relate them to the degradative agents. The table below lists agents and degradation reactions.

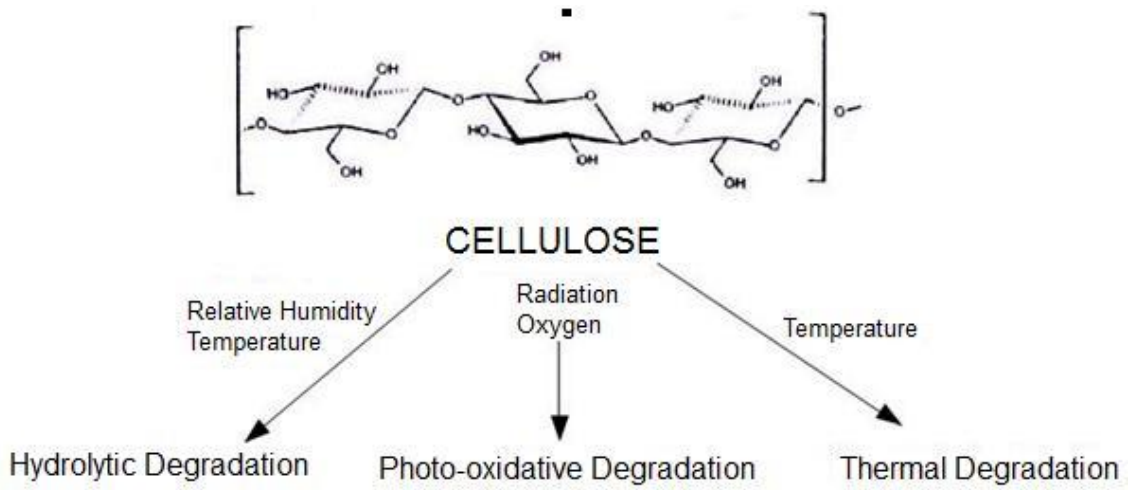

Figure 1 – Cellulose degradation and it's degradative agents

- Hydrolytic Degradation: the presence of moisture breaks the glycoside bonds allowing oxygen to bind to a hydrogen ion in an acid medium, or to an OH grouping in a highly alkaline medium. The chain is broken, it reduces the degree of polymerization and makes the paper more rigid (FIGUEIREDO JUNIOR, 2014, p. 130)

- Photo-oxidative Degradation: it occurs through oxidation, resulting in colorful formations (chromophores, type C = O), yellowing the paper. The necessary energy for the reaction to occur is obtained by radiation and the reaction is dependent on free oxygen in the atmosphere.

- Thermal Degradation: it occurs through oxidation, resulting in colorful formations (chromophores, type C = O), yellowing the paper. The increased temperature promotes dehydroxylation, water loss from the paper by a combination of OH groups and cross-linking.

The simultaneous performance of these factors promotes a combined degradation, which is the advancement of the three modalities together (PORCK, 2000, p. 13). The diagram below shows how each of these degradation reactions occur:

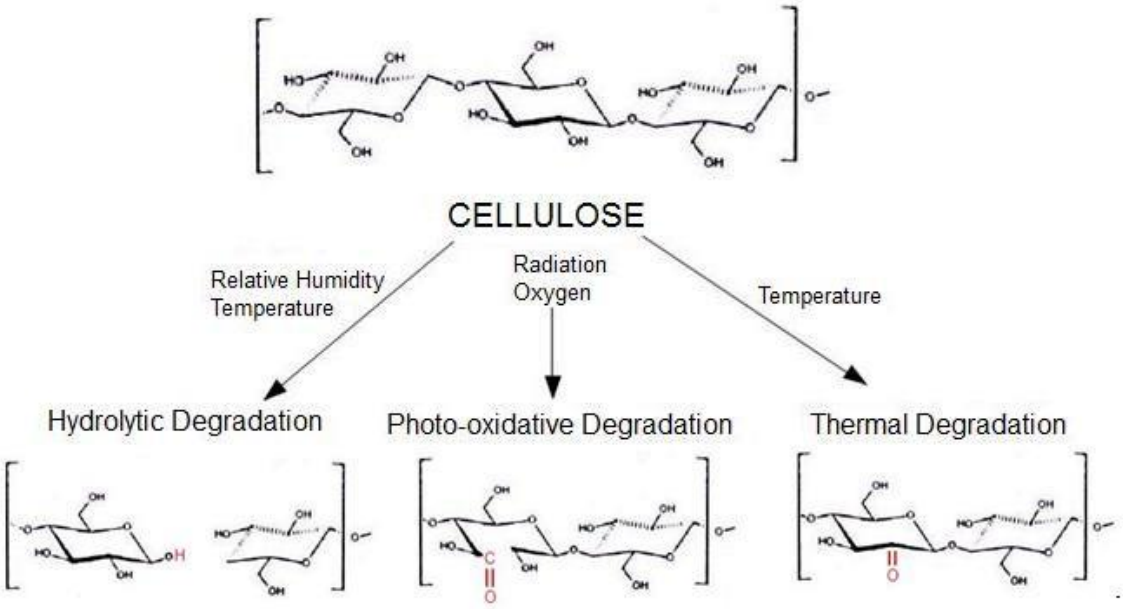

Figure 2 – Cellulose degradation schemes

The diagram shows the acidic hydrolytic degradation. And the photo-oxidative degradation can occur on any carbon, so that this representation is just one of the possible representations (FIGUEIREDO JUNIOR, 2014, p. 131).

If there was a device - a kind of a box – that allow independent handling of some degradation agents which act on cellulose (such as temperature, moisture, oxygen, radiation) it would be possible to analyze the speed of each degradation reactions and also combined. That would let us correlate some support features, at a certain stage of degradation, to their storage conditions.

Controlled Degradation Box: thought experiment

What is being proposed initially is a thought experiment. Imagine a perfectly sealed box containing a copy of your favorite book. You are able to stipulate the temperature and humidity inside the box. You are also able to control the incidence of radiation in the form of visible and invisible light. You can regulate the atmosphere within the box.

Now imagine eight boxes like that one, with eight copies of your favorite book. Each of those boxes presents a different environment. Each environment favors a particular destination for a copy of your favorite book. The boxes and their environment are simulated below, where a sign (+) indicates stimulation and a sign (-) indicates the absence of stimulus.

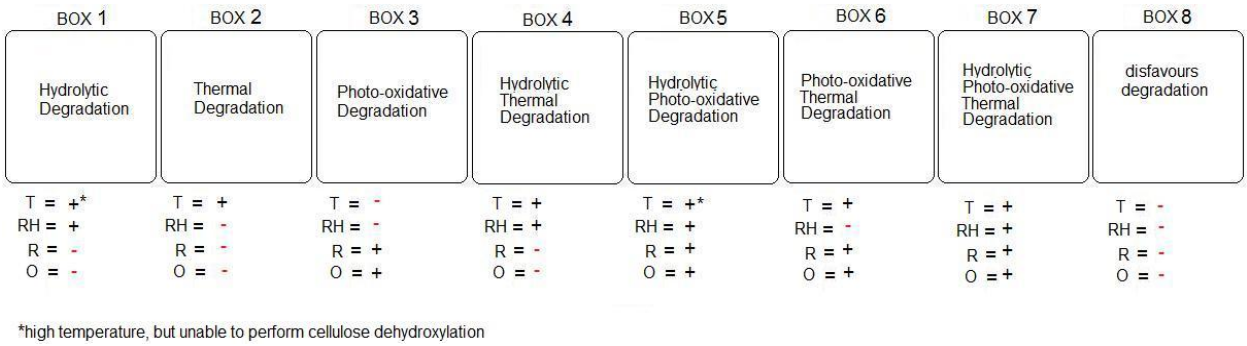

Figure 3 – Eight boxes environments

The cellulose degradation is typically described by the decay of the degree of polymerization (DP), concerning conventional degradation mechanisms (AREA & CHERADAME 2011, p. 14). By measuring the degree of polymerization of cellulose it is possible to observe the rate at which healthy cellulose becomes degraded cellulose

Over the years, monitoring the decay of the degree of polymerization of each of the eight samples will result in eight graphs, with the y-axis being the degree of polymerization and the x-axis time. The construction of these graphs allows us to obtain eight laws of formation of DP x Time functions, which determines the rate of degradation of this type of support in eight different environmental conditions. So it is possible to predict the degree of polymerization in any time. You can find out in which box your favorite book will cease to exist first. It is even possible to know when, no matter what happens, your favorite book will no longer exist.

Final considerations

There are some issues related to the feasibility of this thought experiment in a practical way. Material, energetic and financial issues, for instance. The box design, the values assigned to (+) and (-) in each case and the samples of paper would be subject of big discussions. In addition, it may take a long time in order to observe the polymerization degree decay under storage conditions - since this is not an accelerated ageing experiment, but a natural aging observation. And after all that time, and all the resources, and all the discussions in order to make this experiment feasible, the results may not be relevant due to some yet unknown factors.

However, if we assume that the logic and the equations behind this thought experiment make sense, than the hammer really touches the floor at the same time as the feather. This could be observed by measuring the polymerization degree of different editions of the same book at libraries or collections which are climatologic controlled. Places where the known storage conditions suit the eight boxes environments. This would allow not only the construction of the same DP x Time graphs, and DP x Time functions but also the prediction of the degree of polymerization in any time, and the studied libraries or collections would be able to measure the effectiveness of their climate conditions regarding the permanence of their objects. This places would be able to know the impact in years of their preservation decisions.

As the cultural and technological advances of mankind succeed they promote new cultural and technological advances increasingly faster. We are already producing much more information than we are able to store, preserve and access even in the distant future. It is important that the science of conservation accompanies these advances through a more informed decision-making process with measurable and predictable consequences. The discussion that this work raises, regarding known chemical and climatological bases, is to what extent we will be able to use all the information we already have in order to safeguard what we are still capable of producing.

References

AREA, M. C.; CHERADAME, H. (2011). Paper aging and degradation: recent findings and research methods. Raleigh: *Bioresources*, ed. 6, v. 4, p. 5307-5337

FIGUEIREDO JUNIOR, J. C. D. (2012). Química Aplicada à Conservação e Restauração de Bens Culturais Móveis. Belo Horizonte: São Jerônimo

GLEICK, J. (2013) A Informação: uma história, uma teoria, uma enxurrada. São Paulo: Companhia das Letras

HANNESCH, O & GRANATO, M. A. (2015). Conservação-restauração de documentos arquivísticos: reflexões sobre a tarefa de avaliação e priorização. in GRANATO, M (org.) *Museologia e Patrimônio* p. 204-242. Rio de Janeiro: MAST

PORCK, H. J. (2000). Rate of paper degradation – the predictive value of artificial aging test. Amsterdam: European Comission on Preservation and Access

CONTRIBUTION ON MANAGEMENT OF INDOOR CLIMATE ON HERITAGE: THE INTERNATIONAL COLLABORATION BETWEEN BRAZIL AND NETHERLANDS

Guilherme Zózimo Teixeira Dias – Student on the Undergraduate Course on Conservation and Restoration of Cultural Moveable Heritage of UFRJ

Abstract

The preventive conservation has a main role on the museums, libraries and archives. Its proposal is to preserve, through policies and methodologies of climate management on the environment that the object that is in it.

This article aims to verse on approach of the conservation concepts and applications on the Workshops: Managing Indoor Climate Risks (abbreviated as MICR) , an event organized by LACICOR – UFMG and the Cultural Heritage Agency – Ministry of Education, Culture and Science of Netherlands.

Keywords: collections; climate; conservation

Introduction

The studies on preventive conservation strongly contribute to the preservation of heritage: Consider every degradation propriety on the environment that the object is exposed. Among the many contributions of the Chemistry, Physics, Engineering and other fields of knowledge, climatology and its relations with the object and it different compositions have a huge importance to the heritage protection.

The MICR methodology

The workshop was structured as a 'nine-steps process' that every heritage institute needs to consider in its own management pipeline. From the decision context on which sector needs to be focused on investment according to the institution's goals, to the valuation on measuring the results of the preservation plan, the one-week workshop's main goal is to give tools to professionals on heritage climate management.

The decision context is the construction of the pathway that will reach the outcome. It is the construction of an organized scheme explaining the decision process, not only to guide the institution through to the development of the goal but to explain the arguments that support your proposals on the decision process to future managers and directors of the institution. After this decision process, starts the valuing heritage assets, creating a ranking on which object would have the highest aggregated value to the collection and how much effort is spent on preserving it, granting the institution on charge an overview on the whole value of the collection attributed per object.

As the valuation process ends, starts the third step: considering the risks and the need of the moveable collection. Ranking the needs and risks of the collections provides the institution the degradation ranks that the collection is exposed, from the most weather susceptible objects to the most resistant ones.

As the collection's susceptibility rank is set, starts the same process focused on the building itself. The several materials used on the construction of the building and it's degradation rates would then allow the researchers to identify the risks and consider about the proper climates that each space needs.

As well as the collection and the building itself, a museum and other heritage institutions needs to consider about human needs. The staff and the visitors have a main role on a heritage institute as "guardians and owners" of the cultural assets. Setting up the needs and the risks related to the human influence on the climate can provide the institution with information about human comfort.

At the end of the steps on identifying the needs of the collection, the building and human factor itself, starts the sixth step: The studies on the building itself as its "envelope properties". It is where it is considered the structural changes on the building in order to improve the climate indoors.

The combination of those four previous steps is based on the decision path proposed at the decision context, results in a seventh step. It is here where the institution set the climate specifications (sta of each space in the building, from the storage room to the exposition. Those shall be the values that the institution will aim in each area.

As the eighth step, the mitigation strategies are the proposals on how to create and sustain the climatic control that should be implemented. This step is based on the valuation method presented at the second step and the seventh step. Its the considerations on how to adapt the environment to the object, considering the envelope characteristics of the building, or proposing a microclimate (as called in the workshop as box-inside-a-box) on a showcase with an individual climate setup.

The ninth and last steps are the analysis of the strategies presented in the eighth step. Shall be considered many possibilities of approach and cost-benefit of each one. It is the studies on how worth was the financial investment and the risk prevented.

It's necessary to highlight that nine steps process wasn't the only topics of the lectures. There were also lectures on how to process the Relative Humidity and Temperature data on isometric charts; lessons on how active system work and how so; A lecture about vibrations and its consequences to the conservation and so on, with many contributions by the UFMG professors.

The applicability of the methodology and its influence on the preventive conservation:

The scheme created by Bart Ankersmit and Marc HL Stappers can be applied to a great range of heritage institutions, not only on museums (besides the one being referred as the main goal). Archives, libraries, galleries can validate the method as the manager professionals consider about new investments, planning the actions according to its interests.

This approach on preventive conservation differs from the classic Thomson's contribution on *The Museum Environment*, who suggest an ideal setup for temperature and relative humidity, not only considering the explicit needs of the collection and the building but considering the objective and the sustainability of this investment as well as the peculiarity of the region's climate.

Guichen points in the *La conservation préventive: un changement profond de mentalité (ICOM-CC, 1995) a illustration* for the contemporary perspective on the preventive conservation studies and the efforts on the conception of the workshop:

> Preventive Conservation is an old concept in the world of museums but it is only within the last 10 years that it has started to become more organized. It requires a profound change in mentality:
> Where yesterday one saw objects, today one should see collections.
> Where one saw rooms, one should see buildings.
> Where one thought in days, one should now think in
> years Where one saw a person, one should see teams
> Where one saw short-term expenditure, one should see long-term investment.
> Where one shows day-to-day actions, one should see programme and
> priorities.
> Preventive conservation means taking out a life insurance for museums collections.
> (GUICHEN, 1995)

As the workshop aligns with the perspective of a preventive conservation that involves every professional (and even visitors) of the heritage institute, the knowledge provided by the lectures grant the listener tools to detect problems on the management of the heritage, from the decision context to the judgement on achieving of the goal on the end of the process.

References

ANKERSMIT, B.; STAPPERS, M.L.H. Handouts Managing Indoor Climate Risks. Minas Gerais, 2016

ASHRAE Handbook -- HVAC Applications: Chapter 23, Museums, Galleries, Archives, and Libraries (I-P), Atlanta: ASHRAE, 2015

GUICHEN, G. Cahiers d'Études. Comit de Conservation (ICCOM-CC). Bruxelles, 1995 <avaliable at http://archives.icom.museum/study_series_pdf/1_ICOM-CC.pdf>

MUSEU DA IMAGEM E DO SOM – BH

Isabel Cristina Felipe Beirigo – Cultural Heritage Technician

Abstract:

The Museum of Image and Sound of Belo Horizonte is an institution of memory responsible for the audiovisual collections preservation. In order to better fulfill its function, it has an air-conditioned reserve for storing the collection, one of its main concerns being temperature and relative humidity control.

Keywords: audiovisual heritage; MIS BH; audiovisual collections preservation

Introduction

The Museum of Image and Sound (MIS) is an institution linked to the Municipal Foundation of Culture, Municipality of Belo Horizonte. Acting from 1995, until 2014 under the name of Audiovisual Reference Center (CRAV), the Museum is responsible for the audiovisual collections preservation of the city, both those produced in the capital and those that deal with it. In order to deal with the collection issues and think about the institution and its needs, the Permanent Committee on Collection Policy (CPPA) was created in 2014, whose responsibility is to ensure that the Collection Policy is implemented and observed in all actions of the Museum, with a view to preserving the audiovisual collection under its responsibility. In addition, the Committee is responsible for carrying out security measures that are essential to ensure the protection and integrity of the cultural assets under its custody, as well as users, employees and facilities.

The museum is located in the city of Belo Horizonte, Minas Gerais, whose climate is Tropical, with moderately hot and humid summers and dry winters.

The MIS collection consists of several items related to the audiovisual: films (35 mm, 16 mm, 8 mm, Super-8); Video material on various tapes (VHS, Betacam, U-matic, Hi8, MiniDV etc); Photographic items (paper, acetate negatives, glass negatives, slides etc);

Cinematographic posters; Books, scripts, magazines; Vinyl discs, K7 tapes, magnetic audio rollers.

Figure 1 – Museu da Imagem e do Som, by Isabel Beirigo.

Storages

The museum has an air-conditioned storage with temperature and relative humidity control. The storage is divided in: 5 air-conditioned rooms, with central air conditioning, 1 antechamber and 4 films storages.

Figure 2 – Antechamber, by Isabel Beirigo

The antechamber serves as a space for guarding the videographic, photographic, items of the bibliographic and iconographic collections. It is also the space used for acclimatization of the film collections, since the temperature of this environment is slightly higher than the rest of the rooms, turning around 20 ° / 21 ° C and relative humidity 55% to 60%.

The films rooms are divided according to the physical conditions and processes of deterioration of the film archive. They have temperature and relative humidity of the air controlled by the Climus system and rotate around 17 ° and 19 ° C and relative air humidity around 60% and 65%.

Film room 1: keeper of healthy collection, that doesn't yet present the Vinegar Syndrome; Has 2.6 x 2.83 x 1.3 meters; Equipped with 12 fixed shelves and holds approximately 1728 cans/film cases, containing approximately 7733 films.

Figure 3 – Film Room 1, by Isabel Beirigo

Figure 4 – Film Room 2, by Isabel Beirigo

Film Room 2: also a room of healthy collection, specifically of 16 mm films, B & W, negative; the room has 2.6 x 5.45 x 3.38 meters; equipped with 20 fixed shelves and holds approximately 2880 cans/film cases, containing approximately 11259 films.

Room 3 Film: guarded of vinegary collection, that is, already entered the deterioration process known as Vinegar Syndrome; the room has 2.6 x 3.65 x 2.1 meters; equipped with 6 fixed shelves and holds approximately 864 cans/cases, containing approximately 1687 films. It should be noted that in future the size of this room will be a problem for MIS, given the fact that healthy films tend to become acid.

Figure 5 – Film Room 3, by Isabel Beirigo

Figure 6 – Film Room 3C, by Isabel Beirigo

Film Room 3C: keeps the collection that besides the Vinegar Syndrome presents other problems, such as crystallization, pronounced bulging, drained emulsion, etc. Not all films in this room are lost, but there are a good many of them that need to pass through the CPPA for disposal. The room has 2.6 x 1.87 x 1.75 meters; equipped with 3 fixed shelves and holds approximately 432 cans/cases, containing approximately 687 films.

The Museum Building

The MIS's building is a 1920s construction originally designed to be a residence. The administrative areas occupy the first floor of the storages are on the ground floor. Part of the collection is in air-conditioned areas, with temperature control and UR, but the collection of three-dimensional objects is not in an air-conditioned room.

The building is masonry, with thick walls. But there are damp spots in some areas. The room that holds the three-dimensional objects has points of humidity, requiring constant maintenance to avoid that the collection is affected. In addition to the moisture problem,

this collection is exposed to heat, lack of air circulation and inadequate space for the number of objects.

Some problems

There are two main problems facing MIS:

1 - need for better control of Relative Air Humidity in film reserves;

To solve such an issue it would be interesting to lower the temperature a little more in these rooms, in addition to the use of dehumidifiers. In addition, it would be important to reformulate the air-conditioning ducts system in order to improve the temperature of rooms 3 and 3C.

2 - high humidity and temperature in the room of objects.

In order to solve this issue, it is important to formulate a project for the reform of the museum's stock of objects, isolating as much as possible the internal area from external interference. In addition, it is necessary to solve the problems of infiltration in the walls, the installation of air conditioning and dehumidifiers in the environment.

Final considerations

Although the Museum of Image and Sound has a good structure to safeguard its collection, some modifications are necessary. However, in the case of a public institution, there are many difficulties in securing funds to make the necessary adjustments.

Indoor climate risks of MASP- Museu de Arte Assis Chateaubriand

Miriam Elwing – Project and Facilities Manager at MASP

Abstract:

MASP has the most important collection of European art of the south hemisphere and a iconic building designed by the renowed italian architect Lina Bo Bardi. Along the years the inpacts of physycal interventions on the building and HVAC improvements have not been properly measured. A monitoring and interventions plan to the building has to be ellaborated to ensure the proper collection preservation.

Keywords: monitoring, plan, collection

Introduction

MASP is a private not-for-profit museum founded by businessman and journalist Francisco de Assis Chateaubriand and Italian art critic Pietro Maria Bardi in 1947 and today is considered to have the most important collection of European art of the Southern Hemisphere. Listed by Brazil's Historical and Artistic Heritage Institute (IPHAN) in 1969, in recognition of its significance, its collection currently includes some 8,000 works, mostly Western art from the 4th century BC to the present day. In addition to its permanent collection and temporary exhibits, the museum has constantly held cultural and educational programs such as concerts, courses and workshops.

Today MASP is internationally recognized not only for its collection, but also for its iconic building owned by the Sao Paulo city government and designed by renowned Italian-Brazilian architect Lina Bo Bardi. Lina Bo Bardi designed a building that seems to be supported by the two enormous pre- stressed concrete beams resting on equally massive pillars that we see from outside. However, there are two more similar beams inside that actually do most of the structural support. The span between the columns is 74 meters and the two main facades are enclosured with glass.

The building has a split through its midsection, burying half of it below the terrace and lifting the other half into the sky. As a result, the architect created a plaza between the floors that remains open and unobstructed.

The climate risks for the building and the art collection

Since the construction of MASP head office at avenida Paulista, many physical interventions were implemented with impacts on the indoor climate conditions, such as the construction of drywalls to enclosure the second floor gallery,supposedly to control the sun radiation on the external glass, and the posterior demolition of these walls and application of protective films on the external enclosure. Also the HVAC system has been expanded along the years, and a automation system has been implemented.

Even having termohigrografs and graphics of the indoor climate conditions for the last 20 years, the museum didn´t develop a sistematic plan of monitoring the climate variations, and it´s relation with the physical interventions on the building, or in the HVAC system. The influence of the external climate on the internal conditions is not fully understood, and a methodology is to be stablished to a better compreension of the various factors influencing the indoor climate conditions.

Some key questions are to be answered:

1.Is it worth it to invest in HVAC system improvements or it would be better to invest in the building physical envelop to improve the indoor climate conditions? Recent interventions in the building include the closing of one art gallery with an automatic glass door and the substitution of the inside drywall enclosures by film applied over the glass. Are there other possible building improvements?

2. Is it worth it to invest money in a new sensors system, user friendly and also precise, to monitor humidity and temperature conditions? What is the better format for the monitoring graphics?

3. What is the ideal range of humidity and temperature for each item of the collection?

4. Is it worth it to improve the automation system with sensors inside the art galleries? Other investments on HVAC such as open the fancoils and split the resistances , the humidification system and the serpentine makes a difference?

5. Lack of maintenance would explain the deterioration of the climate conditions on areas like the storage room?

6. What is the effect of the frequent civic events and music shows on the ground floor over the structure? Should the museum forbidden these events?

Figure 1 – MASP with the red columns, 2012 ©Érico Vieira

Figure 2 - Art Gallery with original glass easels – 70's ©Paolo Gasparini

Final considerations

In the last two years the museum administration guidance is to recover the original characteristics of the building, and to improve the museum image and the visitors´experience.

To improve the indoor climate conditions of the building is important not only for the collection preservation, but also to improve the visitors´experience. It is a challeging goal, considering the building enclosure in glass. To reach this goal a consistent plan must be ellaborated to first understand the problem , and then propose the best possible solution.

References

SUZUKI, M. and, ROCHLITZ. R. (2014). A Estrutura do MASP, de Lina Bo Bardi , Revista AU, Edição 249, São Paulo:

MIYOSHI, A.G. (2007). Arquitetura em suspensão: o edifício do Museu de Arte de São Paulo. Dissertação (Mestrado) – História, Instituto de Filosofia e Ciências Humanas, Universidade Estadual de Campinas. Campinas: 2007

LANGDON, D. (2014). AD Classics: São Paulo Museum of Art (MASP)/ Lina Bo Bardi. <http://www.archdaily.com/537063/ad-classics-sao-paulo-museum-of-art-masp-lina-bo-bardi> Access in 2016/11/28.

Sobre o MASP – Museu de Arte de São Paulo Assis Chateaubriand <http://masp.art.br/masp2010/sobre_masp_missao.php> Access in 2016/11/28