International Scientific Workshop

Heritage Science and Sustainable Development for the Preservation of Art and Cultural Assets

On the Way to the GREEN Museum

Conference Booklet

Rathgen-Forschungslabor
Staatliche Museen zu Berlin

SCOPE OF THE WORKSHOP

The term "Green Museum" brings together conservation science with the sustainable development for the preservation of art and cultural heritage. This involves three closely related issues: firstly, the preservation and conservation, i.e. the widest possible extension of life expectancy for our cultural heritage; secondly, the economic and infrastructural conditions for it; and finally the ecological energy and resource issue (energy efficiency, carbon footprint). In the sustainability debate, these three aspects can only be considered and evaluated together.

The 'Green Museum' is a museum that embraces the concept of sustainability in its program, its activities and its physical presence.

Here conservation science programs share a particular responsibility. An important element of sustainable development in the field of museums and monuments is preventive conservation with all its elements, including the various challenges of climate, temperature and humidity, light, pollutants etc.

The professional field of conservation and conservation science (Heritage Science*) has developed continuously since the foundation of the Rathgen Research Laboratory on the April 01st, 1888 as the first museum laboratory, especially in recent decades.

Conservation research activities have to focus and need to develop modern concepts in interdisciplinary collaborations that are consistent with both the primacy of heritage conservation as well as environmental and financial desiderata. They must integrate all three dimensions of sustainability, ecology, economics and society in order to cope with the immense challenges of the future.

The international workshop, organized with the support from the German Research Foundation (DFG), is held on the occasion of the 125th anniversary of the Rathgen Research Laboratory. It aims at bringing together leading scientists and experts for presentations and discussions on three main topics:

1. Understanding material behavior
2. Understanding environments
3. The economic and ecologic dimension

* "Heritage science is a field of endeavour that bridges the divide between the humanities and the sciences. By using and developing science to understand, manage and communicate the human story expressed through landscape, buildings and artefacts, heritage science encourages the humanities and sciences to collaborate and strengthen each other" [http://www.english-heritage.org.uk/NHSS].

This definition of 'Heritage Science', as proposed by the British 'National Heritage Science Strategy Steering Group', describes in a excellent way the synergetic interrelation between humanities and sciences, and it acknowledges the social importance of this domain.

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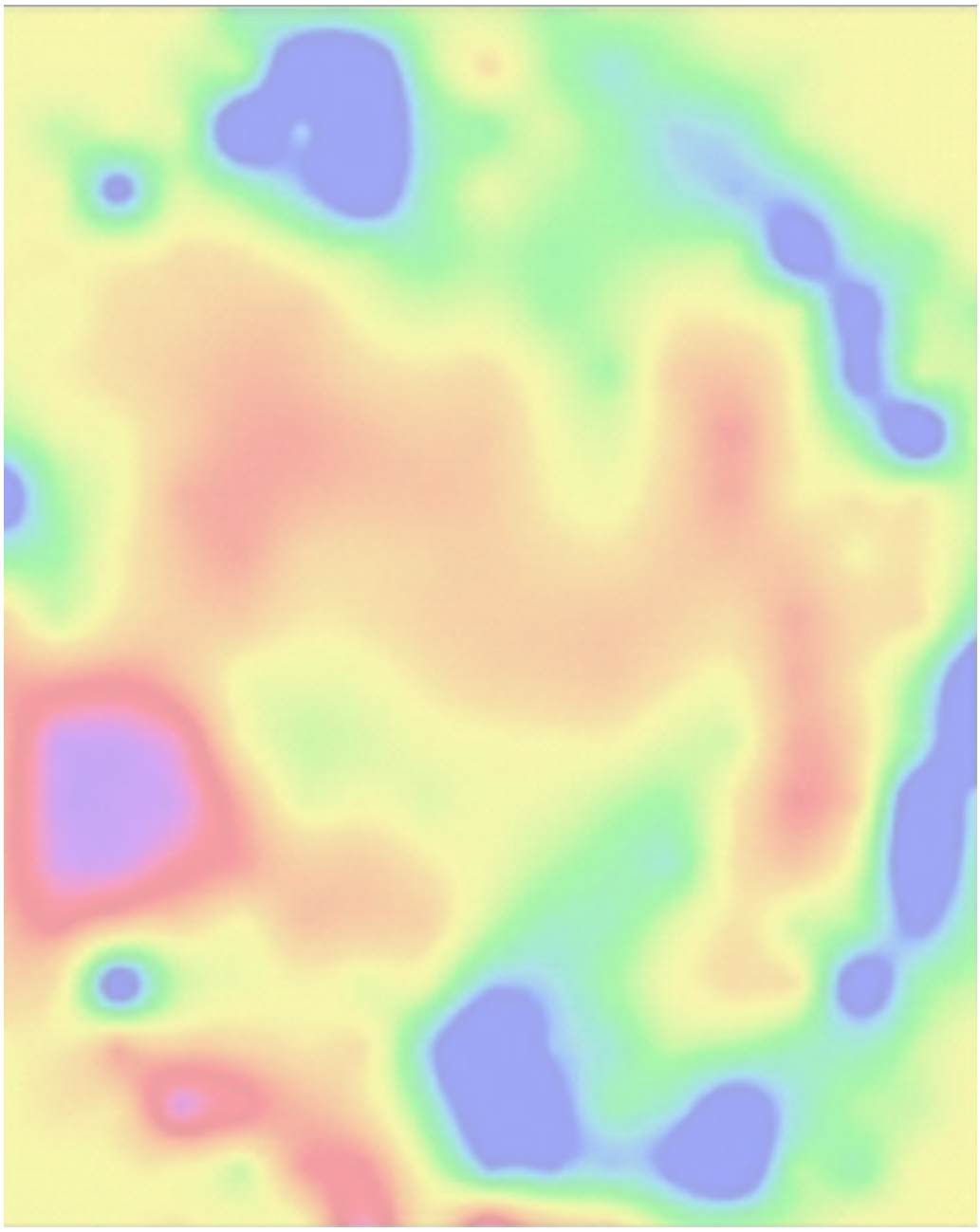

CONFERENCE DETAILS

CONFERENCE DETAILS

COMMITTEES

Scientific committee

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Acknowledgements

We owe thanks to Katrin Abromeit, Matthias Bruske, Bernd Hauke, Arndt Möller, Theresa Rauch, Bernd Rottenburg, Bernd Schlüter, Maike Schmidt, Malin Sundermann, Naja-Anissa Staats, Maria Thomassen and Cybele Tom.

Supported by

German Research Foundation (DFG)
The DFG is the self-governing organisation for science and research in Germany. It serves all branches of science and the humanities. In organisational terms, the DFG is an association under private law. Its membership consists of German research universities, non-university research institutions, scientific associations and the Academies of Science and the Humanities.

Research Alliance Cultural Heritage
The Prussian Cultural Heritage Foundation is member of the Research Alliance Cultural Heritage (Forschungsallianz Kulturerbe, http://www.forschungsallianz-kulturerbe.de), established in 2008 with the partners Fraunhofer-Gesellschaft and Leibniz Association.

CONFERENCE DETAILS

Conference Date and Venue

The conference takes place from the 11th to 12th April 2013. Lectures are given in the Theodor Wiegand Hall in the Pergamon Museum.

Due to ongoing construction works the Pergamon Museum can only be accessed via Bodestraße 1-3, 10178 Berlin.

How to get to the Pergamon Museum by public transportation

S-Bahn S5, S7, S75 (Hackescher Markt); S1, S2, S25 (Friedrichstraße)
U-Bahn U6 (Friedrichstraße)
Tram M4, M5, M6 (Hackescher Markt); M1, 12 (Am Kupfergraben)
Bus TXL (Staatsoper); Bus 100, 200 (Lustgarten); Bus 147 (Friedrichstraße)

Coffee breaks and Lunches during the conference

Refreshments during the coffee breaks are available free of charge for registered participants at the conference venue. Various options for lunch can be found in restaurants around the Museums Island.

Internet

WIFI access in lecture hall shall be provided.

SOCIAL EVENTS

Thursday, April 11th, 2013

08:00 pm Evening Reception at Pergamon Museum

Saturday, April 13th, 2013

10:00 am and 01:30 pm Visit of the Rathgen-Forschungslabor
10:00 am and 01:30 pm Guided tour at the Neues Museum in the Exposition ‚In the Light of Amarna. 100 Years of the Nefertiti Discovery' (english tour)

Places for the tours are limited. Please register for the tours at the registration desk.

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By participating at the Workshop, you consent to interview(s), photography, audio recording, video recording and its/their release, publication, exhibition, or reproduction to be used for news, web casts, inclusion on web sites, or for any other purpose(s) that the Prussian Cultural Heritage Foundation deems fit to use. You release the Foundation, its officers and employees, and each and all persons involved from any liability connected with the taking, recording, digitizing, or publication of interviews, photographs, computer images, video and/or or sound recordings.

Insurance (Disclaimer)

Please note that the organizing committee cannot be held responsible for any damages, injuries or losses that might occur during the conference or your stay in Germany.

CONFERENCE DETAILS

GENERAL TRAVEL INFORMATION

Getting around by Public Transportation

You need a ticket to use public transportation system run by the BVG. Tickets can be bought at ticket machines which offer menus in different languages (English, French, Spanish, Italian, Turkish). Ticket machines can be found in the stations, on platforms or in the tram. Alternatively tickets can be bought in shops with the yellow BVG sign or at the bus driver (exact change is appreciated). Most destinations are within the zone AB (Tegel Airport is in Zone B; but the Airport Berlin Schönefeld is in zone C). A zone AB single faire is € 2,40; the a day ticket AB costs € 6,50. If you do not want to travel any further than three urban rail or underground stations or no more than six bus or tram stops, then it pays for you to purchase a Short Trip Ticket (€ 1,40). More information on http://www.bvg.de or in the brochure in your conference bag.

Banking and Cash Machines

Cash machines can be found almost everywhere. The closest cash machine to the conference venue can be found near the stations Hackescher Markt and Friedrichstrasse, a 5 minute walk from the Pergamon Museum.

Shopping

In most quarters of Berlin (Prenzlauer Berg or Kreuzberg) you can find small shops with Berlin-style goodies. Big department stores can be found at Kurfürstendamm and Alexanderplatz. Especially recommended are the flee markets in Berlin, where you can buy almost everything (from furniture to vinyl disks), if the weather is right. On Sundays you can visit a flee market at the *Mauerpark* in Prenzlauerberg and combine it with a walk next to the historical Berlin Wall that separated the city from 1961 to 1989. In walking distance of the *Mauerpark* is the Berlin Wall Memorial (Bernauer Straße 111/119, 13355 Berlin).

PROGRAM

PROGRAM

THURSDAY, APRIL 11TH, 2013

09:00 – 10:00		Registration	
10:00 – 10:30		**Welcome addresses**	
		H. Parzinger, President, Stiftung Preußischer Kulturbesitz	
		S. Simon, Director, Rathgen-Forschungslabor	
10:30 – 11:30		**I: Understanding material behavior**	
	I-1	Material analysis elucidating alteration processes of works of art	C. Herm
	I-2	Large dimension, varying materials, unfavourable environment: the special case of industrial heritage	S. Brüggerhoff
	I-3	Learning from the extremes: outdoor monument corrosion	M. Mach
11:30 – 12:00		Coffee break	
12:00 – 13:00		**I: Understanding material behavior**	
	I-4	Weathering of Medieval stained glass	M. Schreiner, M. Melcher, M. de Bardi
	I-5	Impact of the environment on the performance of salt contaminated building materials of archaeological sites	H. de Clercq
	I-6	The mode of formation of acetate salts in museum environments	M. Steiger
13:00 – 14:30		Lunch break	
14:30 – 15:30		**I: Understanding material behavior**	
	I-7	From celluloid to biobased plastics: What's new?	T. B. van Oosten
	I-8	Lightfastness measurements of light sensitive materials using the Micro-Fading Tester (MFT)	C. Maines
	I-9	Remain in light: approaches to gallery lighting at the V&A	B. Pretzel
15:30 – 16:30		Coffee break with *Poster Session*	

16:30 – 17:30		**I: Understanding material behavior**	
	I-10	Degradation of aerosol fluorecent paints found in works of art: case study of a painting on canvas from the artist Pasmore	A. Colombini, A. Sautois, J. Schiró
	I-11	Consensus re-examined: the response of lined canvas paintings to fluctuating relative humidity	C. Krarup Andersen
	I-12	Determining allowable environments for cultural materials and objects	M. F. Mecklenburg
17:30 – 18:00		**Open discussion: Understanding material behavior**	
20:00		Evening Reception at Pergamon Museum	

FRIDAY, APRIL 12TH, 2013

09:00 – 10:20		**II: Understanding environments**	
	II-1	Microbiological colonization of materials as an indicator of the environmental change	A. A. Gorbushina, O. L. Smolyanitzkaya
	II-2	Low-VOC and zero-VOC products – helpful tools on the way to a „green“ museum?	A. Schieweck
	II-3	Modelling climate change impact on cultural heritage – the European project Climate for Culture	J. Leissner, R. Kilian
	II-4	Energy efficient museum stores and archives in Denmark – a review	P. Klenz Larsen, M. Rhyl Svendsen, L. Aasbjerg Jensen, T. Padfield
10:20 – 10:50		Coffee break	
10:50 – 12:10		**II: Understanding environments**	
	II-5	Environmental management strategies for green museums: consideration for hot and humid climates	S. Maekawa
	II-6	Towards a systems-based methodology for sustainable design, refurbishment and management of museums	F. Adorno, G. Foliente, D. Bisceglie, N. Mendes Maccarini
	II-7	From green bronzes to green museums: integrating Rathgen‘s idea of humidity controlled cases within the design of a sustainable museum system	S. Michalski
	II-8	Environment monitoring and control techniques used in National Museum of China	Zhang Jin Ping

PROGRAM

12:10 – 13:40		Lunch break	
13:40 – 14:40		**II: Understanding environments**	
	II-9	Allowable microclimatic variations in museums and historic buildings: reviewing the guidelines	Ł. Bratasz
	II-10	The Bizot initiative: a dilemma for preventive conservation?	A. Burmester
	II-11	Risk and uncertainty: precaution and honesty	J. Ashley-Smith
14:40 – 15:10		**Open discussion: Understanding environments**	
15:10 – 15:40		Coffee break	
15:40 – 17:00		**III: The economic and ecologic dimension**	
	III-1	Carbon footprinting museum loans: tools and findings	S. Lambert
	III-2	Saving energy in the National Museum in Krakow, Poland – a case of green climate management	M. Łukomski, Ł. Bratasz, R. Kozłowski
	III-3	The current trend of green museum in Japan	T. Ishizaki
	III-4	Sustainable climate control in museums – preservation and economics	T. Broström, C. Gaskell, G. Leijonhufvud
17:00 – 17:30		**Open discussion: The economic and ecologic dimension**	
17:30 – 17:45		**Concluding Remarks**	

SATURDAY, APRIL 13TH, 2013

	Social Program places are limited, please register
10:00	Visit of the Rathgen-Forschungslabor
10:00	Guided tour at the Neues Museum
13:30	Visit of the Rathgen-Forschungslabor
13:30	Guided tour at the Neues Museum

POSTERS

	I: Understanding material behavior	
I-P1	Investigations on the deterioration of gneiss of Andron A building of Labraunda Archaeological Site, Milas-Turkey	K. G. Akoglu, T. Topal, Y. Kaya
I-P2	Bio-inspiration and optics	C. Andraud
I-P3	PANNA – Plasma And Nano for New Age soft conservation	C. Aibéo, E. Egel, S. Simon
I-P4	Nanotechnology for museums: a sustainable solution	E. Curto, F. Fernandez, V. Salerno
I-P5	Multispectral imaging – digital documentation, monitoring and pigment identification of art objects	E. Egel, S. Simon
I-P6	The use of absorbents for the conservation of cellulose acetate magnetic tapes	E. Gómez-Sánchez, S. Kunz, S. Simon
I-P7	Vibration behavior of paintings and the consequences	K. Kracht, U. von Wagner
I-P8	Biofilm: using biocellulose film to document graphics preservation	C. S. Morais, G. M. Bakiewicz
I-P9	Evaluation of starch-based materials for conservation of historic stones	Qu Jia, He Ling
	II: Understanding environments	
II-P10	Climatic aspects for the preservation of mural paintings in the churches of Brandenburg	B. Arnold
II-P11	Analysis of a sustainable site specific museum design experience for the Opera of Santa Croce‘s Museum	F. Bosi, F. Baldi
II-P12	Dust in Museums – Not just a question of aesthetics	M. Hadian Dehkordi, C. Aibéo, S. Simon, C. Herm
II-P13	Measurement and assessment of air quality in the Malek National Library and Museum Institution and the Reza Abbasi Museum in Tehran	M. Hadian Dehkordi, G. Maas-Diegeler, S. Röhrs, S. Simon, C. Herm, R. Vatandoust
II-P14	Sustainable ventilation and cooling of museums	K. J. Käferhaus
II-P15	Georgian National Museum environmental management and case of Oriental art collection	N. Kalandadze, M. Tsereteli
II-P16	Analysis of historic carbolineum treatments with respect to decontamination	A. Nusser, E. Gómez-Sánchez, A. Schwabe, K. Osterloh, S. Simon

II-P17	Daily temperature fluctuations caused by light sources	M. Pamplona, S. Simon
II-P18	'Temperierung' as a tool for preventive conservation – an assessment	S. Raffler, S. Bichlmair, R. Kilian
II-P19	Measurement of air pollutants in showcases by Proton Transfer Reaction Mass Spectrometry	S. Röhrs, J. Kames, A. Acksel, E. Gómez-Sánchez, S. Simon
II-P20	Technical specifications of showcases at the National Museums Berlin: theory and praxis	S. Röhrs, M. Pamplona, A. Schwabe, S. Simon, U. Heuer
II-P21	Margravial Opera House in Bayreuth - concepts and planning for indoor climate in the frame of a major conservation and building measure	M. Staschull
	III: The economic and ecologic dimension	
III-P22	Identification of pesticides in ethnographic collections – an Argentinian-German case study	M.J. Fernández, F. Marte, S. Simon, R.R. Pausewein, E. Gómez Sánchez
III-P23	Garbage in the context of cultural heritage	M. Gholami
III-P24	Pesticide contamination and cultural heritage	E. Gómez-Sánchez, S.Simon
III-P25	Energy performance contracting at the Kulturforum, Berlin	U. Heuer
III-P26	Without Bio"Green" in Green Museum – Eco-friendly Museum Pest Control	B. Landsberger, S. Simon
III-P27	Green museums in the secondary schools of Spain	M.D. Ruiz de Lacanal Ruiz-Mateos
III-P28	Analytical methods to determine wood protective agents	M. Torge, D. Brödner, I. Feldman, S. Krug, H. Mathies, B. Mull
III-P29	Domestic service and preventive conservation	A. Wright
III-P30	Archaeology today and tomorrow - scientific and museum work on archaeological finds facing big construction projects on land and sea	M. Yoshida, U. Warnke, L. Klemm

To download the abstracts as a ZIP-file (8,5 MB) type the following link in your browser:

https://dl.dropbox.com/u/13019569/Abstracts.zip

I: UNDERSTANDING MATERIAL BEHAVIOR

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MATERIAL ANALYSES ELUCIDATING ALTERATION PROCESSES OF WORKS OF ART

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The chemical analysis of materials forms a major part of the scientific examination of works of art. Firstly, evidence of the original technique may be collected. Furthermore, the detection of products of aging, corrosion, and weathering can indicate previous processes of alteration by physical, chemical, and biological influences. Although non-destructive methods are favourable for the analysis of works of tart they generally can yield only information from the surface. Thus it is still necessary to apply a wide range of modern technology to samples from the object. By means of several case studies the paper gives an overview of material analysis from easel paintings, sculptures, and mural painting. The detected alteration products from pigments, binders, and inorganic and organic substrates are interpreted in terms of alteration processes as well as of the original appearance of the respective object of art.

LARGE DIMENSION, VARYING MATERIALS, UNFAVOURABLE ENVIRONMENT: THE SPECIAL CASE OF INDUSTRIAL HERITAGE

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As a course of the increasing de-industrialization in Germany important objects of industrial times have been classified as parts of cultural heritage of the country. This is indicated by an increasing number of technical and industrial museums but also by numerous industrial monuments, listed by the federal countries. Actually Germany has four World Heritage Sites demonstrating the industrial past of the country (coal mine and coking plant Zollverein, Essen, ironworks Völklinger Hütte, ore mine and processing plant Rammelsberg, Goslarand Fagus production site in Hannover).The decisive factors are the identity-establishing character and the symbolism of a society defining period of the near past. However, not before the 1970s the negative meaning of the objects ('mud-slinger', place of hard graft, angriness because of job loss caused by closing down) has been changed to a predominantly positive image (industrial culture, cathedrals of work, pride of once own past). Thus preservation of technical and industrial heritage is a quite new task for conservation scientists.

Technical objects and even more industrial sites have never been created for a permanent survival. They have been constructed, built and maintained for a life orientated to the economic rules of the production process. Therefore common approaches of monument preservation are exceeded here in kind and dimension. Conservation measures for technical and industrial objects need to consider following problems:

- complex material and structural characteristics
- 'consumption' character dedicated to a temporary service life time (e.g. blast furnaces were regularly renewed by lining with heat-resistant bricks)
- huge spatial dimensions
- pollution caused by former production process, causing accelerated corrosion
- restricted financial resources not allowing an overall conservation of the entire site or machine park in a reasonable timeframe, causing graded safeguarding and maintaining measures during already running visitor activities

Preservation of testimonies of the industrial past thus requires new attempts in conservation. The present contribution will show examples resulting from the demonstration mine of the mining museum in Bochum and the open-air museum iron-works Henrichshütte in Hattingen. Environmental loads but also solution approaches to preserve iron and steel constructions from corrosion keeping the monument character will be presented and discussed with regard to the ideas of a 'green museum'.

I: UNDERSTANDING MATERIAL BEHAVIOR

LEARNING FROM THE EXTREMES: OUTDOOR MONUMENT CORROSION

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The term „on the Way to the Green Museum“ in the program title implies that at the moment some museums might be considered as being more or less far from „green“, far from perfection. On the other hand it goes without saying that most museums are in fact islands of tranquility in a world full of environmental catastrophes, military conflicts, air pollution and many other risk factors.

So, when thinking about the borderline between the museum and the rest of the world there can be no doubt that one should be aware of all the risks beyond the fence as well. Not only because some of them might partially or totally penetrate into the museum from time to time but also in order to study their detrimental effects in unmitigated strength and enhanced clarity.

In the past decades several big European projects have investigated the impact of the most important outdoor atmospheric pollutants upon metal specimens exposed on racks all over the world. Many of those projects were performed in those lucky ancient times when funded projects or funded project chains were still allowed to span over reasonable time periods like five or even 10 years. Some major results and conclusions from those projects will be exemplified.

Furthermore, outdoor monuments made of metal all over the world have fulfilled a kind of secondary, victim role: they have become long-time sensor objects prone to the complete set of hostile influences - including really bizarre impacts as for example corrosive artificial snow from film productions, wartime metal collection activities or crazy fashions like the car-friendly city.

And, last but not least, many of those monuments have been standing outside in times of extreme air pollution, some of them in really hopeless regions with pollutant concentrations similar to those used by corrosion engineers in accelerated weathering tests. Besides, there has always been a persistent hope that one might still be able to perfectly protect those metallic objects exposed to unfavourable conditions, e.g. by means of inhibitors, organic or inorganic coatings. The outcome of this human endeavour can be studied in the „outdoor reality laboratory“, too.

WEATHERING OF MEDIEVAL STAINED GLASS

Manfred Schreiner [1,2], Michael Melcher [1,2], Monica de Bardi [1,2]
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Medieval stained glass has been used for window panes in cathedrals, churches, or other historic buildings. These artifacts, consisting of numerous pieces of glass colored with metal oxides, show accelerated deterioration, particularly on their exterior surfaces. One reason for the low weathering stability is the chemical composition of the glass, which is characterized by a high content of potassium and calcium oxides and a low amount of silica in comparison to modern commercial soda glasses. The continuous exposure of the potash-lime-silica glass to the ambient air has yielded to the formation of a so-called weathering crust on the glass surfaces, which mainly consists of gypsum ($CaSO_4$ x $2H_2O$) or syngenite (K_2SO_4 x $CaSO_4$ x H_2O) as crystalline and hydrated silica as non-crystalline weathering products. Consequently, the transparency of these glass paintings is reduced and in many cases the entire composition is barely recognizable. Furthermore, the thickness of the glass panel is also reduced.

In order to investigate the weathering mechanism of that type of glass, specimen with a chemical composition similar to medieval stained glass were exposed to polluted atmospheres in climate chambers as well as under natural conditions within an EU-supported international exposure program (MULTI-ASSESS). After exposure times of several months (field exposures) the sample surfaces and their cross-sections were investigated in the scanning electron microscope in combination with energy-dispersive microanalysis (SEM/EDX). The results have shown that the weathering process is dominated by an ion exchange process of the mono- and bivalent network modifiers such as K and Ca and hydrogen bearing species such as H_3O^+ from the ambient air. Consequently, a so-called leached layer is formed on the glass surface, where the glass constituents K and Ca are depleted and hydrogen is enriched. Statistical evaluations of the leaching data for the network modifiers K^+, Ca^{2+}, Na^+ and Mg^{2+} indicate selective leaching of the main network modifier (K^+) compared to all other ions. Dose-response functions (DRFs) relating the measured leaching depths and the environmental and climatic conditions reveal statistically significant influences of the concentrations of SO_2 and NO_2, the temperature (T) and the relative humidity (RH) in air on the weathering process.

Additionally, surface analytical investigations were carried out using ToF-SIMS (Time of Flight Secondary Ion Mass Spectrometry) and IRRAS (InfraRed Reflection Absorption Spectroscopy) for studying the chemical and structural changes on the glass surfaces during the weathering.

IMPACT OF THE ENVIRONMENT ON THE PERFORMANCE OF SALT CONTAMINATED BUILDING MATERIALS OF ARCHAEOLOGICAL SITES.

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Crystallization of salts is recognized as a major factor in the degradation of porous materials in built heritage. Salt weathering is a universal phenomenon affecting rocks and man made materials all around the world. There is an overwhelming literature available on the simulation of salt damage effects.

In the absence of a liquid moisture source crystal growth in a porous material is always the result of a phase transition reaction induced by changes in temperature or relative humidity (RH). Hence, unfavourable environmental conditions may cause repeated cycles of deliquescence-crystallization or hydration-dehydration, which can lead to the decay of building materials.

However, most researches deal with single salts. Situations get more complicated if one passes from single salts, of which the deliquescence points are well documented, to real practice situations. An inventory of the type of cations and anions in almost 1000 samples taken from Belgian historic buildings proved that building materials seldom contain one particular type of salt, but rather a complex mixture of ions which makes the prediction of the behaviour of salts in a mixture complex.

The assessment of the critical environmental conditions of salt contaminated porous building materials, and hence potential risks of salt damage, requires the knowledge of the thermodynamics of the relevant phase transition reactions. In the framework of a research project funded by the European Commission, a computer program ECOS (Environmental Control of Salts) was developed capable of predicting the crystallization behaviour of salt mixtures as a tool to predict environmental conditions to minimise salt damage. The output enables the user to determine ‘safe’ ranges of relative humidity and temperature in which phase transitions are kept to a minimum.

In this contribution, the results of several archaeological built constructions are discussed such as, the ice houses of Oudergem, the Coudenberg archaeological site in Brussels with the remains of the former palace of Charles V and the Mikweh in Cologne (G). The experimental determination of the salt content of building materials is dealt with, in the framework of a proper rehabilitation of the site and a prediction of the behaviour of the salt mixture related to the climate.

THE MODE OF FORMATION OF ACETATE SALTS IN MUSEUM ENVIRONMENTS

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Salt crystallization is a major cause of damage both in porous building materials and in museum artifacts. Damage is caused by the growth of salt crystals in the porous structure of materials such as stone or ceramics. Acetate containing salts are frequently observed in efflorescences on calcareous objects in museum cabinets. Their formation is the result of the attack of acetic acid enriched in the atmosphere of wooden cabinets. The low air exchange rates in display cases and storage cabinets provide favorable conditions for the enrichment of volatile pollutants such as acetic acid. In fact, several authors report very high acetic acid concentrations in cabinets, even in very old ones. Hence, acetic acid attack is not only the result of a high exposure in the past, but is an ongoing process leading to the continuous formation of acetate salts. The salts identified in efflorescences on museum objects include pure calcium acetates as the hemihydrate or the monohydrate, the double salts $Ca(CH_3COO)Cl{\cdot}5H_2O$ (calclacite) and $Ca_2(CH_3COO)_3(NO_3){\cdot}2H_2O$, and, finally, a widespread but initially unidentified efflorescence that was later characterized as a triple salt with the composition $Ca_3(CH_3COO)_3Cl(NO_3)_2{\cdot}7H_2O$ (thecotrichite). In this contribution we will discuss in detail the mode of formation of these compounds on museum objects.

FROM CELLULOID TO BIOBASED PLASTICS: WHAT'S NEW?

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Plastics are so intertwined in our daily life that a life without this material is hard to imagine.
Moreover, museum collections nowadays contain increasing amounts of plastic objects. The development of plastics has come from the use of natural plastic materials such as shellac and horn, to the use of chemically modified natural materials such as rubber, cellulose compounds and milk proteins and finally to fully synthetic molecules such as Bakelite, and polyvinyl chloride (PVC) amongst others.

The quality of plastics with regard to durability is not what museums would wish for. Plastic degrades, despite the fact that some believe that plastics are unbreakable and imperishable. For some time conservators, restorers and scientists have been confronted with objects showing signs of deterioration. More than twenty years in plastics conservation research has revealed the types of plastics that have shown degradation and their related kinetics. Semi synthetic plastics such as the cellulose based plastics such as cellulose nitrate (Celluloid) and cellulose acetate has shown degradation within 20 - 40 years. Fully synthetic plastics are more durable and degrade very slowly; the chemical bonds that make plastic so durable make it equally resistant to natural processes of degradation.

However, the impact of the last fifty years of unbridled plastics production, use and disposal is now becoming well known and documented. Plastics made from non-renewable petroleum and natural gas resources threaten the environment, human health, species maintenance and the very life of the ocean.

Plastic waste disposal is a huge eco-technological problem and one of the approaches to solving this problem is the development of biodegradable plastics. Some commercially successful biobased plastics are based on chemical synthesis (i.e. polyglycolic acid, polylactic acid, polycaprolactone, and polyvinyl alcohol). Others are products of microbial fermentations (i.e. polyesters and neutral polysaccharides) or are prepared from chemically modified natural products (e.g., starch, cellulose, chitin or soy protein).

Bioplastics or biobased plastics are plastics in which all carbon is derived from renewable feedstocks. However, biobased plastics contain both renewable and fossil-based carbon. They may be or maybe not be biodegradable. The percentage of biobased ingredients vary widely. Therefore, the conditions under which the biobased products may biodegrade, if at all, very too.

Biodegradable plastics degrade upon exposure to sunlight (e.g., ultra-violet radiation), water or dampness, bacteria, enzymes, wind abrasion, and in some instances, rodent, pest, or insect attack are also included as forms of biodegradation or environmental degradation. Some modes of degradation require that the plastic be exposed at the surface, whereas other modes will only be effective if certain conditions exist in landfill or composting systems.

The innovation of biodegradable and compostable plastics technology is an excellent example for a sustainable development, which means the responsible use of available natural resources and production processes that take environmental aspects and natural circulations into consideration. The presentation will focus on the various types of ‘new ’plastics and their impact on conservation.

LIGHTFASTNESS MEASUREMENTS OF LIGHT SENSITIVE MATERIALS USING THE MICRO-FADING TESTER (MFT)

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Since the development of the micro-fading tester by Paul Whitmore in the mid-1990s, many institutions have incorporated micro-fade testing into their decision-making protocols for exhibition conditions for works of art. With the demand for popular and important museum objects to be on ever longer and more frequent display cycles, there is an increased need for conservation professionals to have objective information to support limiting or removing specific light-sensitive objects on display.

The instrumentation is intended for use on objects that are likely to be light sensitive, such as works on paper, early photographic materials, and dyed textiles. The technique relies on measuring the rate of change in the visible reflectance spectrum from an object, calculated from the color measurement values – L*, a*, b* – and comparing that rate of change to the most sensitive ISO Blue Wool Standards – Blue Wools 1, 2, and 3. Objects that change at the rate of Blue Wool 3 or slower are considered outside the range of concern for the test, and are therefore, relatively light stable.

The original micro-fading tester and all subsequent instruments have been assembled, for the most part, from off-the-shelf components. The generalized instrumentation consists of 1.) an intense xenon-arc light source filtered to exclude ultraviolet and infrared radiation and to include only visible light (400nm - 700nm), 2.) a measurement head with solarization-resistant fiber optics and lenses both to collect the reflected light and to deliver and focus the light to a submillimeter diameter illumination spot with an intensity several times that of the sun , 3.) a spectrophotometer for measuring the reflected light, and 4.) a stabilized power supply which permits measuring slight changes in even weak reflectances over the course of several minutes. Several research groups are working to identify improved components, the interoperability of the various components, and on methods to refine the positioning of the measurement head and the repeatability of the measurements. The current paper will discuss these developments as well as give practical tips for using a micro-fading tester in a museum environment.

REMAIN IN LIGHT – LIGHTING STRATEGIES AT THE V&A

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Sustainability considerations, a fear of global warming, and the current economic turmoil (in the west at least) have coalesced within the last decade bringing ever increasing pressure on public buildings to reduce energy demands in general. In the heritage field, the old approach, where climate and lighting design and best practice were defined in terms of what was technically achievable, have given way to more pragmaticstrategies balancing the perceived benefit with associated costs.

Luckily, the last few decades have seen significant developments in the understanding of the effect of variations of temperature and humidity on museum collections. Tightly controlled environmental specifications have been shown to be resource intensive and of limited benefit to the majority of artefacts. The resilience of collections in general to moderate variations particularly in relative humidity together with a realisation that very tight performance specifications are very difficult, if not impossible, to achieve (particularly in old buildings where air conditioning units are retrofitted) has led to arelaxation in climate specifications being accepted in many museums.

Although our understanding of the interaction of light with artefacts has developed only a little in the recent past, the strict advocating of absolute maximum illumination levels, policed by teams of overzealous carers armed with the latest light meters, is now too a thing of the past. More and more, museum lighting professionals base their emphasis on the visual effectiveness of a display, optimising ways of enhancing the appearance whilst limiting the exposure of artefacts to light.

Lighting accounts for approximately half as much energy as climate control (limited to heating and ventilation in most galleries) at the V&A, but lamp maintenance remains a resource intensive task. Half a century after the proliferation of high quality fluorescent and tungsten halogenlamps, reliable LED technology and other solid state lighting alternatives are finally making an impact in the field. Although the investment in new hardware can be daunting, these technologies promise enhanced flexibility in lighting design and energy saving in the medium term.

This presentation illustrates some of the approaches developed at the V&A to address lighting challenges whist minimizing risks to sensitive artefact on display. It will also present our experiences with the latest developments in solid state lighting options and present some of the more successful technology now being introduced, together with assessments of the impact of this new technology on our energy footprint.

I: UNDERSTANDING MATERIAL BEHAVIOR

DEGRADATION OF AEROSOL FLUORESCENT PAINTS FOUND IN WORKS OF ART: CASE STUDY OF A PAINTING ON CANVAS FROM THE ARTIST PASMORE

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Fluorescent paints have been introduced in works of art since the second half of the twentieth century. Artists have widely been using these new colours in paintings as well as inscreen-prints, in textiles and in graffiti. The degradation mechanism of the fluorescent pigments has been little studied in conservation science while manufacturers are racing with the improvement of the formulas to conform with health and safety regulations. The preservation of these colours is becoming a major concern since the new artistic creation processes,along with those of street art,are entering into cultural heritage collections. Therefore, it is particularly motivating to explore the behaviour of such paints facing photochemical and environmental degradations, and the relevant conservation-restoration issues.

The aerosol paints compositions are fairly different and numerous patents are present on the market. The evolution of formulas is also tightly dependant on the propellant gas regulations and on the quality of paints required by artists. Because of these points of view, it is crucial to associate manufacturers and artists to cultural heritage science researches.

This paper relates to the on-going research on Montana fluorescent spray paints, and to a case study of an untitled Victor Pasmore painting from the National Museum of Fine Arts, Valletta, Malta. The scientific investigations have relied on the identification of samples, taken from various areas of the painting, and on the degradation assessment of retouching following a protocol of test samples. Comparative results have been carried out on the test samples which have undergone several artificial light ageing tests.

The degradation assessment of retouching was followed by means of colour changes attributed to binders, to pigment mixture or to the combination of both.Chemical transformations were monitored by FTIR spectroscopy.

Results have complemented the visual assessment for the use of a binder/consolidant in the mixture with a fluorescent pigment as the first choice for retouching. Regarding the poor light fastness of these type of pigments and their induced loss of fluorescence, a preventive conservation strategy is compulsory by means of limiting solar radiation and more specifically, by monitoring the eventual colour change between the retouching and the painted layer.

CONSENSUS RE-EXAMINED: THE RESPONSE OF LINED CANVAS PAINTINGS TO FLUCTUATING RELATIVE HUMIDITY

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The ability to reduce energy consumption in cultural institutions is directly related to the constraint of environmental control of that institution. A tightly controlled interior environment consumes considerably more energy than a loosely controlled environment. It then makes sense to assess structural conservation treatments in view of their impact on an objects ability to safely withstand environmental fluctuations.

This work evaluates the ability of different lining techniques to support canvas paintings in terms of their initial stretching and during fluctuations of relative humidity. Six different combinations of lining adhesives and textiles were examined. These included the adhesives Beva 371, Plextol D360, wax-resin, and traditional glue-paste. The lining textiles were linen and polyester sailcloth. A naturally aged canvas painting and a modern painting executed for test purpose were lined using these materials and methods. Testing of the lined paintings included uni-axial load strain tests to assess the stiffness of the lined painting and check for resistance to initial stretching. This was done to investigate what happens in the painting structure when a lined painting is re-tensioned or keyed out. Restrained tests demonstrate how the lined and re-stretched painting responds to changes in relative humidity. The results were compared to observations of aged, lined paintings at the National Gallery of Denmark.

Contrary to the usual assumption it was found that wax-resin linings on linen canvas responded to high RH with higher contraction forces than was the case before lining. The contraction was evident at RH levels as low as 65%. As a result of the adhesive filling the voids of the linen canvas (both the original and the lining canvas) the contraction due to fiber swelling was immediate. There is some evidence that the same thing is true for liquid Beva in linen canvas. The results further showed that glue-paste lining on a linen canvas offered significant support to a painting at 50% relative humidity but increased the stress level severely in dry conditions and offered no support to the painting at 70-80 % relative humidity. This means that the traditional glue-paste lining techniques and the wax-resin technique in high RH seem to be a limiting factor to the advisable RH fluctuation in a cultural institution. Conversely paintings lined with the polyester sailcloth showed a somewhat increased resistance to RH fluctuations.

Lining on canvas does not provide an efficient alternative to RH control because a tensioned canvas cannot go into compression and therefore cannot protect the paint and ground layers against contraction forces. Stiffness in a lining at relevant moisture levels is decisive for how much the structure can contract. In many cases linings will actually necessitate tighter climate control than needed for unlined paintings.

DETERMINING ALLOWABLE ENVIRONMENTS FOR CULTURAL MATERIALS AND OBJECTS

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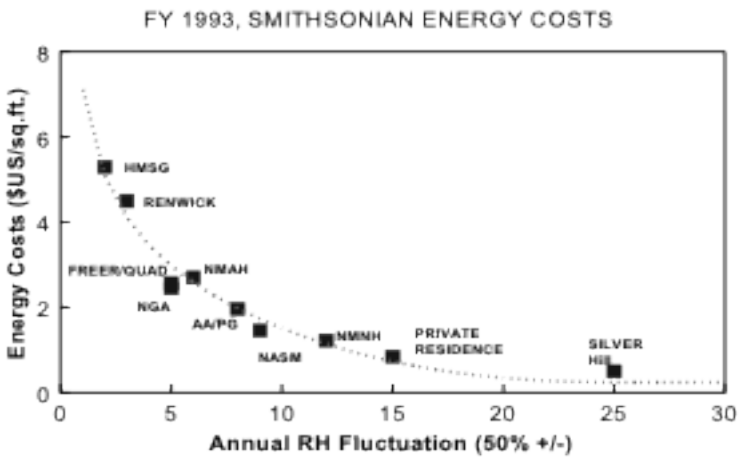
There are many reasons for exploring the environmental ranges that cultural objects are capable of safely withstanding. One of which is the energy consumption associated with tightly controlling a museum's environment. Figure 1 shows the energy cost per square foot versus the environmental control of relative humidity (RH) for several Smithsonian Institution museums and storage buildings in Washington D.C. The annual fluctuation is interpreted as the maximum change in RH over an annual cycle. For a very tightly controlled building such as the Hirshhorn Museum and Sculpture Garden (HMSG) the environmental control is 50% RH +/- 3% RH. As it is seen the energy costs increases exponentially with the increase of control.

The data shown in the Figure is not unique as this is almost identical to the operating costs of other cultural institutions [1].



Shows the energy costs of several Smithsonian Museums and Storage buildings as a function of RH control in the building.

Further, maintaining high levels of RH in the wintertime in older masonry buildings having little insulation can often lead to moisture condensation within the inside surfaces and interior of exterior walls. It can happen to new as well as older buildings. This of course leads to damage to the walls and their interior surfaces and results in high building maintenance costs [2].

The approach to determining the effects of changing temperature and RH on cultural materials can be simplified by making certain worst case assumptions. These assumptions are founded on the basic fact that forces and stresses which cause materials to fail (either plastically deform or crack) result when there are changing environments and the materials are restrained from movement to lesser or greater degrees [3].

In the cases of temperature and RH effects, it is worthwhile to look at typical cultural materials and their mechanical and dimensional behavior to develop a basic approach in assessing their allowable environmental fluctuations.

This paper exams a variety of materials and establishes allowable RH and temperature variations for the worst case conditions. It can be shown that nearly all the cultural materials can withstand RH variations of +/- 15% or greater. Further it will be shown that temperature variations are not significant unless it falls below the glass transition temperature of the different paints. In addition these results will be shown to compare favorably to research results conducted using advanced computer simulations by other researchers.

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I: UNDERSTANDING MATERIAL BEHAVIOR

INVESTIGATIONS ON THE DETERIORATION OF GNEISS OF ANDRON A BUILDING OF LABRAUNDA ARCHAEOLOGICAL SITE, MILAS-TURKEY

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Labraunda archaeological site is situated in the Latmos mountains at north of the city of Milas, Turkey. The sacred sanctuary of its day, Labraunda, consists of several buildings including 'Andron A', a dining hall built for sacrificial feasts at Labraunda's sacred festivals. The main stone type used in the area is gneiss. Today, 'Andron A' bulding, has various conservation problems at different scales. This study focuses on the deterioration problems of gneiss of Andron A building in Laubranda archaeological site in order to develop the most effective, compatible and durable conservation treatments.

The first diagnostic studies were started with the mapping of visual decay forms of the building. These maps were generated by using the measured drawings of the building. Representative deteriorated and non-deteriorated stone samples were collected from the site.. The analyses were done to get information on physico-mechanical properties (i.e., bulk density, effective porosity etc.) as well as the mineralogical and petrographical characteristics of the weathered and relatively non-weathered gneiss. Therefore, together with the mapping of visual weathering forms, ultrasonic pulse velocity (UPV) measurements, thin sections analyses by optical microscopy and XRD analyses were conducted.

The main visual weathering types observed in the Andron A building are the material loss by breakouts, material loss by reliefs, detachment in the form of flakes, cracks/fissures, discoloration and biological weathering. The gneiss has been physically broken down along foliation planes, fractures and grain boundaries. . The changes in the physico-mechanical properties of gneiss by weathering and the effect of the mineralogical content of the building stone (gneiss) being mainly, feldspars, quartz, mica and biotite, on the weathering were discussed in this presentation.

BIO-INSPIRATION AND OPTICS

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„Go take your lessons in nature, this is where our future", this quote from Leonardo da Vinci exemplifies the principle of bio-inspiration.

In a few billion years, life has developed strategies and adaptive impairments that may inspire science and technology.

This holistic approach is promising technologies applicable in the field of conservation that will not harm the environment: clean technologies, recyclable materials, techniques using less energy passive view, thanks to the possibilities found in nature.

We will focus especially on natural photonic structures for which selection has favored a very large architectural diversity, which probably offset the poverty of materials.

Number of living species have a wide variety of remarkable optical properties (camouflage, iridescence, various polarizations, light guide,...) and are at once able to answer to other physical constraints (thermal, mechanical energy...). We will see some examples from nature and some applications can inspire.

I: UNDERSTANDING MATERIAL BEHAVIOR

PANNA – PLASMA AND NANO FOR NEW AGE SOFT CONSERVATION

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The PANNA project aims at the development and commercialisation of 1) a portable atmospheric plasma torch for *in-situ* surface cleaning and coating deposition which satisfies cultural heritage safety demands; 2) self-diagnostic protective coatings based on organic-inorganic hybrid sol-gel and organic coatings technologies and 3) transparent identification markers.

The plasma torch must satisfy cultural heritage safety demands while being able to remove a wide range of dirt and types of old coatings and homogeneously apply a new coating layer. Its portable design makes it practical to be used by conservators, both in the lab and *in-situ*.

The protective coatings, besides common features required to analogous conservation materials, will include innovative self-diagnostic features -- monitoring the performance of the coating will be quickly and easily carried on *in-situ*.

The transparent identification markers are invisible tags for identification and anti-counterfeit purposes.

The final aim of PANNA project is to integrate the developed technological innovations in a protocol spanning surface cleaning, deposition of coatings and their complete removal.

NANOTECHNOLOGY FOR MUSEUMS: A SUSTAINABLE SOLUTION

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The aim of the present study is to evaluate the opportunities of application of nanotechnologies in the field of museums, in the framework of the sustainable development for the preservation of art and cultural heritage. The research project has been carried out within the Master in “Nanotechnology and nanomaterials for Cultural Heritage” of the University of Palermo.

A critical element of sustainable development in museums relates to preventive conservation of the displayed heritage continuously exposed to the effects of external anthropogenic, environmental and temporal agents. Our interdisciplinary research group investigates the economic, environmental potential of nanomaterials applied to cultural heritage exhibitions.

The project comes from the need to design a new layout for the Regional Archaeological Museum of Agrigento (Italy) with a view of sustainability through the use of advanced materials and technologies, such as nanotechnology and nanomaterials.

Nanotechnology nowadays offers the opportunity to operate with advanced performance materials, environmentally friendly and sustainable starting from the production processes.

Nanomaterials are those which have structured components with at least one dimension less than 100nm; at this dimension increased relative surface area, and quantum effects can change or enhance properties such as reactivity, strength and electrical characteristics.

Through the use of eco-friendly nanomaterial, produced in a sustainable way, museums can become the place where heritage meets green technologies. This could lead to enhancing museums’ environmental impacts, preventive conservation and visitors’ experience through innovative and sustainable expositive settings.

MULTISPECTRAL IMAGING – DIGITAL DOCUMENTATION, MONITORING AND PIGMENT IDENTIFICATION OF ART OBJECTS

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The examination of an art object starts with it photographic documentation. By taking images using different ranges of the electromagnetic spectrum, much more information is obtained then what the human eye can see. Multispectral imaging techniques are based on the characteristic absorption properties of each substance and allow acquiring, besides high resolution images of an object, colorimetric or spectral information about the materials of a polychrome surface.

The main components of the multispectral imaging system used at the National Museums Berlin, are a camera, , different light sources, a series of filters, installed in front of the light source or in front of the camera objective, and a grey scale standard for the calibration of the photographs. The method permits to record images of reflected visible light (VIS), reflected ultraviolet light (UVref), reflected infrared light (IRref) and ultraviolet-induced visible fluorescence (UVfluor). Moreover, two new digital images can be generated with an image-editing software: a combination of the VIS photograph with the UVref photograph, respectively IR photograph, will create the UV false color (UVfc) and IR false color (IRfc) images. A color can be therefore characterized by six images.

Multispectral analyses of Buddhist mural paintings from the Museum of Asian Art in Berlin are presented in this poster. Polymeric conservation treatment can be visualized by it fluorescence, the infrared image can be interesting to reveal under-drawings and the false color images are a tool to identify pigments.

THE USE OF ABSORBENTS FOR THE CONSERVATION OF CELLULOSE ACETATE MAGNETIC TAPES

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The level of acetic acid to which museum objects are exposed to is critical to their conservation state. Tetréault has proposed, for example, a 10 years preservation target level of 100 µg/m³, which is commonly used as a standard for permanent storage. By avoiding the use of materials which release acetic acid and other pollutants, critical degradation processes of museum objects can be avoided.

But, what happens when the object itself is the source of the released pollutant? Cellulose acetate materials, often found in magnetic tapes used for the storage of sound, are subject to the hydrolysis of the ester groups with concomitant release of acetic acid. The process is triggered by ambient humidity and, once a critical concentration of acetic acid is reached, the reaction proceeds autocatalytically.

The process (known in the archival world as 'vinegar syndrome') renders the material brittle and, in the case of magnetic tapes, ultimately leads to the loss of the stored information by making the tape unplayable. Since the acetic acid released by a certain tape is potentially able to accelerate the degradation process of a 'healthy' tape stored nearby, the prompt identification of (affected) cellulose acetate tapes is essential in archives.

The music archive of the Ethnological Museum (National Museums Berlin, Germany) houses a large collection of unique ethnological recordings on phonograph cylinders and magnetic tapes. The large number of recordings (more than 10.000 magnetic tapes) and the limited resources demand a rational digitisation strategy which targets more vulnerable materials first. The ILKAR project (ILKAR, German acronym for Integrated Solutions for the Preservation, Archiving and Conservation of Endangered Tapes and Cylinders) was launched with the aim of developing easy ways of identifying endangered magnetic tape materials which may become unplayable in the near future. The project, which ran from 2008 to 2011, had Rathgen Research Laboratory (National Museums Berlin, Germany) as the other main partner.

In order to lower the acetic acid concentration in the surroundings of cellulose acetate film, *Kodak molecular sieve* is commonly used as an absorbent in film preservation. The absorbent is able to trap the free acetic acid as well as water in the environment of the film, both molecules involved in the degradation process.

The use of such absorbents has not been evaluated yet for magnetic tapes. The present study makes a first attempt by comparing five different absorbents, *Kodak molecular sieve*, molecular sieves (4 Å), sodium hydroxide, sodium hydrogencarbonate and disodium hydrogen phosphate dodecahydrate on a reel-to-reel tape affected with vinegar syndrome.

To test their effectiveness, both the relative humidity and the pH (*A-D Strips* developed by the Image Permanence Institute) were monitored during the experiment. Passive sampling and ion chromatography were then used to comparatively evaluate the amount of free acetate in the surroundings of the tape in the presence of the different absorbents, as compared with the blank experiment. Three of the five tested adsorbents were successful at lowering the acid concentration below the previously published autocatalytic point for a tape with advanced hydrolysis signs.

VIBRATION BEHAVIOR OF PAINTINGS AND THE CONSEQUENCES

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Oil paintings of the old masters are valuable not only for education and social life but also from an economical point of view. These artworks undergo vibrations due to multiple reasons. During exposition there is excitation by public or external traffic load. Higher excitation levels are reached during transports. Consequences may be the emergence of cracks or loss of paint slabs.

For protecting an oil painting from damage it is essential to be aware of its condition. Conventional techniques applied by conservators are based on visual detection. In contrast to this, the poster presents an analysis method based on knowledge from machine dynamics applied.

For testing the presented method dummies in the manner of the old masters were prepared by a docent of Berlin University of Arts. They were aged at different levels by a research institution for paint and varnish at Magdeburg. After aging the dummies are investigated for their dynamical behavior using different excitations (harmonic, broad-band). Special laser equipment and the experimental set up were developed for measurements on the surface of painted canvas. Strong influences of the weathering of the dummies and characteristic vibration behavior especially nonlinearities could be observed during these measurements. Cracks were initiated during dynamic fatigue tests and correlated with dynamic responses.

The presented work should finally lead to condition monitoring of oil paintings and techniques for the prevention of artworks from vibrations.

BIOFILM: USING BIOCELLULOSE FILM TO DOCUMENT GRAPHICS PRESERVATION

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Introduction

Aiming at the reality and needs of the professional conservator restorer works on paper, the laboratory NUCLEM, the SENAI Theobaldo De Nigris, invested in projects of Technological Innovation. This work includes the optimization of the process of consolidation in paper, using a mantle of cellulosic membrane, composed of pure cellulose microfibrils, forming a material with excellent archival qualities, economically viable an environmentally sustainable.

Methodology

In partnership with the Institute of Technological Research and the Role of Laboratory SENAI Theobaldo De Nigris, we analyzed the structural parameters, strength parameters, parameters of appearance and aging tests on more than 300 samples. The tests consisted of the systematic application of adhesives *Neutral pH Wheat Starch*® and *Mashed Neutral pH Methyl Cellulose*® in select samples of paper off set and roles of chemical pulp, mechanical pulp and rag paper. In all tests, we used the ISO standards as a basic for reference testing.

Results and discussions

During application of the samples and developed tests, we found that the membrane is a material resistant to high temperatures and pressure and resistant to nearly all types of chemicals and is insoluble in organic solvents only. The material presented possess great strength, malleability, plasticity and is impermeable to liquids, a fact of great importance in cases of materials hit by accident, since the film create a membrane envelope protecting the document or artwork. The membrane does not possess towards cellulosic fiber, facilitating the application of the material in the work. The cellulosic membrane can also be used as a slurry, acquired by processing in a blender, can be used of the role filings. Or also as substitute *Carboxy Methyl Cellulose*, once shaped pulp. The mat has great sustainability cellulosic materials compared to existing ones, since it is produced by microorganisms without the need to cutting trees for their production, being produced in appropriate culture medium without control of relative humidity or renewing air present in the environment during cultivation, uses a small amount of water in your preparation and all waste from the manufacturing process are handled directly in a water treatment plant itself, causing low impact on the environment.

Conclusion

The use of cellulosic membrane in a conservation and restoration activities has proven extremely effective and versatile showing that is possible to develop and use a sustainable material and apply a correct and safe method for the treatment of works on paper.

EVALUATION OF STARCH-BASED MATERIALS FOR CONSERVATION OF HISTORIC STONES

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Three starch-based materials are prepared in this paper for the conservation of historic stones.

The first one is the starch/ nanosilica hybrid composite obtained through starch gelatinization and the hydrolysis-condensation of tetraethyl orthosilicate (TEOS, $Si(OCH_2CH_3)_4$). When TEOS/ starch is controlled as 5/100, the starch/ nanosilica hybrid composite has a maximum of suspending nanosilica and the best stability. The second one is the modified starch by fluorosilicone copolymer obtained by free-radical copolymerization and sol-gel process through starch, vinyltrimethoxysilane (VTMS, $H_2C=CHSi(OCH_3)_3$) and dodecafluoroheptyl methacrylate (12FMA, $H_2C=C(CH_3)CO_2CH_2CF(CF_3)CHFCF(CF_3)_2$). The modified starch gains the improved thermal stability and the lower surface free energy owing to the fluorine-rich surface. When 12FMA/VTMS=1/1 and hydroxyl group of starch/ fluorosilicone = 1/1, the film shows much favorable characteristics. The third one is VTMS-starch/ fluorinated acrylic copolymer latex obtained by grafting silane onto starch and grafting the fluorinated acrylic polymers onto the silane modified starch by emulsion polymerization. The copolymer of methyl methacrylate (MMA), butyl acrylate (BA) and 2,2,2-trifluoroethyl methacrylate (3FMA, $H_2C=C(CH_3)CO_2CH_2CF_3$) is used as fluorinated acrylic copolymer to obtain VTMS-starch/p(MMA/BA/3FMA) latex.

Fourier transform infrared spectroscopy (FTIR), Dynamic light scattering (DLS), transmission electron microscopy (TEM), X-ray photoelectron spectroscopy (XPS), static contact angle (SCA), scanning electron microscopy (SEM), thermogravimetric analysis (TGA) and differential scanning calorimeter (DSC) are used to characterize the properties of three starch-based materials.

The performance of the three starch-based materials used for the conservation of ancient stones is evaluated. Capillary water absorption, water absorption and contact angle measurements are proceed in order to evaluate the water-resistant efficiency. Salt crystallization cycles and freeze- thaw cycles are conducted in order to understand the possible anti-weathering ability.

II: UNDERSTANDING ENVIRONMENTS

II: UNDERSTANDING ENVIRONMENTS

MICROBIOLOGICAL COLONIZATION OF MATERIALS AS AN INDICATOR OF THE ENVIRONMENTAL CHANGE

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There is a growing concern that ecosystems respond to anthropogenic changes of environment not only by gradual changes, but also by abrupt stage shifts. The new, sometimes undesirable alteration may be difficult to revert, even if environmental pressure is relaxed. Such persistent changes in biological communities or ecosystems can be used for bioindication purposes in assessment of environmental change and anthropogenic impact.

In favourable environmental conditions microscopic growth accumulations dominated by microorganisms develop on all material/atmosphere interfaces and are referred to as "subaerial biofilms". These biofilms are frequently dominated by micromycetes that play an important role in the biodeterioration of museum objects made of organic (wood, polymers, paper and textiles) as well as inorganic materials (stones, glass and metals).

The subaerial biofilm microscopic diversity represents an equilibrated multi-component open ecosystem sensitively reacting to all environmental factors.

All parts of these diverse communities react very sensitively to such external changes as (i) microclimatic conditions and (ii) organic deposition from the material or atmosphere. These changes can be sensitively monitored and analysed using up-to-date microbiological and molecular biological methods. The bioindicative potential of these unique microbial communities was until now grossly underestimated. In this presentation our special concern is given to the changes as they occur in the museum environment. Biofilm or biopatina growth is suggested as an efficient and powerful indicator of (micro)climatic changes.

LOW-VOC AND ZERO-VOC PRODUCTS – HELPFUL TOOLS ON THE WAY TO A "GREEN" MUSEUM?

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Nowadays, the need for "green" museums is globally an important topic. The discussion covers not only ecological and economic solutions of running a museum building, but also how to create an indoor environment both beneficial to museum collections and to human health. As a consequence of this global going green movement, products which are advertised as emitting no volatile organic compounds into indoor air are increasingly released to the market. These so called "low-VOC" or "zero-VOC" products are suggesting a high environmental benefit to the user and are therefore also under consideration for the application in museum interiors. The question therefore arises whether these products deliver what they promise and if they might be a helpful tool on the way to a "Green" Museum?

Therefore, the emission potential of low-VOC and zero-VOCpaints was investigated as well as the efficiency of paints which shall purify the air by degrading pollutants or blocking formaldehyde emissions from medium density fiberboard (MDF). The talk will present the results and will highlight the potential benefit of these paints by comparing their ingredients and emission potential with those of conventional products, such as solvent borne and water borne paints. Moreover, helpful and reasonable strategies for achieving low-polluted indoor air will be discussed as well as the frequently demanded necessity for environmental standards and guidelines.

II: UNDERSTANDING ENVIRONMENTS

MODELLING CLIMATE CHANGE IMPACT ON CULTURAL HERITAGE – THE EUROPEAN PROJECT CLIMATE FOR CULTURE

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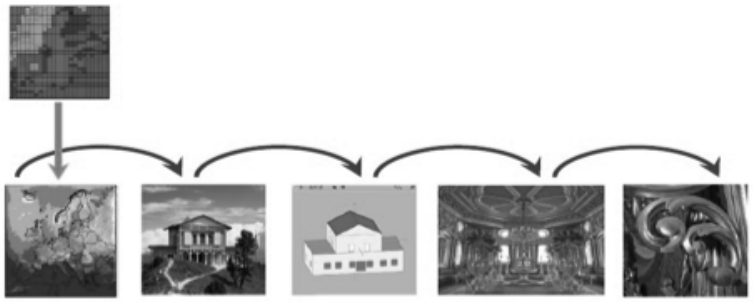
Climate Change is one of the most critical global challenges of our time. Since many decades a huge number of scientists from all over the world are researching this topic and are developing complex climate models which will be suitable to make future climate projections. Climate change in itself is not the main concern; more important is its impact on the planet. But less certain information is available how the changing climate affects mankind and its environment. Although many studies have been conducted to explore the impact of climate change on e.g. biodiversity and agriculture or on fresh water availability, only little is known whether and how climate change influences our cultural heritage. Within the integrated European funded project Climate for Culture running from 2009 until 2014 a multidisciplinary research team consisting of 27 partners from the EU, Croatia and Egypt is performing research to make substantial contributions to estimate the impacts of climate change on the indoor environments in historic buildings and their vast collection s in Europe and the Mediterranean.

For this purpose, the CLIMATE FOR CULTURE project has started for the first time ever to connect completely new high resolution climate change evolution scenarios with whole building simulation models to assess future projections of outdoor climate changes on the indoor environments in historic buildings and its impacts on cultural heritage items in Europe and Egypt.



The Climate for Culture project short cut. From the global climate model to high resolution regional climate simulation to case study historic buildings to whole building simulation to indoor environments and to individual cultural heritage items.

The main scientific innovation of the project consists of the:

- Development of a regional climate model over entire Europe including Upper Egypt with a resolution of 10x10 km
- Development of a whole building simulation tool adapted to historic buildings
- And finally the coupling of climate simulation with building simulation which has never been performed before.

ENERGY EFFICIENT MUSEUM STORES AND ARCHIVES IN DENMARK – A REVIEW.

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This paper is a review of more than ten different museum stores and archives in Denmark. They were all designed to run at low energy consumption, while at the same time keeping acceptable climatic conditions for the collections. Some have worked now for more than 20 years and have thereby proved to be a reliable and sustainable solution for long term preservation. There is no contradiction between saving energy and saving collections. On the contrary, reducing the energy consumption is possible while at the same time extending the lifetime of many types of objects. This comes from the fact that all chemical reactions depend on the temperature. Allowing the temperature to fall below the human comfort zone in winter reduces the rate of chemical degradation. The further benefit of reduced or abandoned winter heating is that there no need for humidification. The relative humidity is controlled by the temperature. In summer there may be a need for mechanical dehumidification but good humidity buffering will allow winter heating alone as the RH control. There are several ways in which this concept can be realized in terms of buildings structures. It was the general agreement for many years that a very heavy building was needed to have sufficient thermal stability. Such structures are rather expensive to build, and the embedded energy is large, so more lightweight solutions have been tested. Highly insulated and airtight buildings in one level with an uninsulated floor perform best in a lifetime analysis. The issue of air quality becomes very important for a building without ventilation. Extensive monitoring has shown that the air is actually cleaner when the intake of outside air is very low. The risk of fire and theft is not greater than in more heavily build stores. We fell safe to conclude, that long term preservation of most museum collections is possible with very little use of energy. Since most museums hold the majority of the collections in store, we are confident that the green museum is well within reach.

ENVIRONMENTAL MANAGEMENT STRATEGIES FOR GREEN MUSEUMS; CONSIDERATION FOR HOT AND HUMID CLIMATES

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Sustainable environmental management for museums requires a good understanding of the environmental requirements of collections; logical allocation of specific uses of individual spaces in the building; and the ability to manage the physical environment as well as the infrastructure and finance necessary to maintain a reliable operation.

Conservation assessments of collections and their current and past environmental conditions should be analyzed to determine appropriate collections environments. If an object is native to a hot and humid region, a cool environment may not benefit the object and a dry environment may result in permanent damages of the object. If the collections were exposed to a wide range of climates in the past, a narrow range of environmental conditions is not necessary. However, if the collections were treated and their thermal and/or hygric behaviors have become severely restricted, a narrower environmental range should be applied. Since impacts of various treatments are often not well understood, the appropriate collections environment may need to be experimentally determined.

The usage of individual indoor spaces should be determined prior to designing and implementing a mechanical system. If the space is allocated for collections only, the collections environment, which requires controls of humidity and indoor air quality (IAQ), should be maintained 24-7. If it is set for people only, thermal comfort, IAQ, illumination, and acoustic comfort all need to be satisfied. However, control is needed only during the occupied period. Collections and people sharing spaces require more control and energy, since they need to fulfill both requirements.

The management of environment starts from the surrounding landscape and the building envelope. They should be examined to eliminate or reduce moisture and heat sources. The building envelope should be improve for its thermal characteristics and reduce infiltration. The mechanical equipment should be selected to produce desired psychrometric processes for achieving the target environment, and the capacity of the equipment should be determined to produce the highest energy efficiency of operation. However, one needs to be realistic about the organizational limitations to maintain and operate the equipment. These are essential for the sustained operation of the system.

When a climate is characterized as high temperature and high moisture, the conventional air-conditioning system needs to perform both cooling and dehumidification. As a result, the energy consumption significantly increases. Major equipment and energy saving can be achieved by limiting the control to relative humidity only. Several examples of environmental management approaches, that are alternative to the conventional air-condition based systems, are presented for cultural institutions in hot and humid climates.

TOWARDS A SYSTEMS-BASED METHODOLOGY FOR SUSTAINABLE DESIGN, REFURBISHMENT AND MANAGEMENT OF MUSEUMS

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The concept of sustainability for museum facilities is a natural part of the museums' mission to preserve the past for present and future generations. But the sustainability and environmental impacts involved in a museum's planning, development, refurbishment and operations are not always explicitly and/or rigorously taken into account. Ignoring these impacts (e.g. inefficient resource use and increased greenhouse gas emissions) runs counter to the fundamental concepts of preservation and sustainability. Guidelines and rating or certification systems for museum buildings lag behind those for other types of buildings (e.g. commercial). This paper aims to identify the key factors and the priority R&D needed to facilitate *a culture,* and *the practice,* of sustainable museum design, construction, refurbishment and management that are appropriate and relevant to a museum's particular goals and that are scalable based on systems thinking. Current research and the features and capability of building rating or certification systems for museums are critically reviewed and assessed. Then a methodological framework for developing and assessing the sustainability of museum facilities across their life cycle is developed by considering a *typological classification of museums* and the combination of a *performance approach* ("thinking in terms of ends rather than means" (Gibson 1982, Foliente 2000) and *n-Bottom Line* outcomes (demand-driven, systems-based sustainability assessment; Foliente et al. 2007). From this general framework, specific guidelines and assessment requirements can be developed that take into account both the state of the physical facility and the museum's core mission/goals. The R&D and the case studies needed to develop this in full are identified and prioritised. Immediate implications to current practice and in the development of museum green rating systems are also identified. This paper maps the needs and a way forward towards an alignment of museums' goal to preserve cultural heritage with society's goal towards sustainability.

FROM GREEN BRONZES TO GREEN MUSEUMS: INTEGRATING RATHGEN'S IDEA OF HUMIDITY CONTROLLED CASES WITHIN THE DESIGN OF A SUSTAINABLE MUSEUM SYSTEM

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On this 125th anniversary of the Rathgen Research Laboratory, with the theme of sustainable museums, it is appropriate to recognize that by 1905 Rathgen had made the first RH controlled display case, that he understood the critical role of airtight design and of moisture sorbents, and that he did so with a clear understanding of which risk was being mitigated (rapid bronze corrosion). By 1907, Meyer in Dresden published (in English) his success in using airtight cases to control pollution, advocating metal and glass construction for reliability. For the next 100 years, however, museum application of these ideas remained marginal, overruled by curatorial need for "flexible and open" displays and operational "simplicity". The result has been a presumption of total facility control by active systems which are not only energy extravagant but a risk to collections in the long term (from the perspective of the many decades or centuries of an objects life, mechanical systems fail regularly). Neither collection risk management nor green directives will allow this denial to continue. In practice, microenvironments have been haphazard and uncertain in their implementation due to their conceptual and operational isolation from departments responsible for the macro environment (building scale). Conversely, building wide systems are designed with no presumption of case and package control. Humidity and pollutant control in the museum constitutes a de facto system that can integrate the strengths and weaknesses of each of the layers of enclosure, from building through case to packaging. The author has developed a model of this system, with simplifying equations to help designers, which will be presented.

ENVIRONMENT MONITORING AND CONTROL TECHNIQUES USED IN NATIONAL MUSEUM OF CHINA

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For building a green museum, the automation monitoring and control techniques are very important. The paper will introduce our practices in National Museum of China. The monitoring techniques include museum indoor real-time climate (temperature and relative humidity) wireless communication meshwork monitoring system and air quality (SO_2, NO_x, O_3, Formaldehyde, TVOC, PM10, PM2.5, PM1, etc.) real-time monitoring system. The environment control techniques include Heating, Ventilation and Air Conditioning (HVAC) System, Communication Automation System (CAS) and Building Automation System (BAS).

1. We use ZigBee as the museum indoor real-time climate wireless communication meshwork monitoring system. ZigBee is based on IEEE802.15.4 standard and is a comparatively low cost, low power, short coverage wireless network telecommunication technology. The accuracy of sensors for monitoring temperature and relative humidity is +/- 0.2 C and +/- 2%RH. These sensors require low power and they send the data through radio waves by ZigBee with rather high telecommunication efficiency.

2. The air quality real-time monitoring system which include the analysis instruments (SO_2, NO_x, O_3 analyzers) and a timed sample device which polytetrafluoroethene pipelines connecting with 5 sample points, each 20 minutes sample one point. The timed sample device is self designed and made. The data is automated recorded by the connection PC. Also we monitoring Formaldehyde, TVOC, PM10, PM2.5, PM1, etc by using the instruments.

3. My Museum uses the IQ3 controllers for Building Automation Management System controllers which control HVAC System that use Ethernet and TCP/IP networking technologies. Each controller incorporates a web server which can deliver user specific web pages to a PC or mobile device running internet browser software. If a system is set up with the correct connections, a user with the appropriate security codes can monitor or adjust the controller from any Internet access point in the world. It is also compatible with the traditional IQ system protocol. This range of DIN rail mounting controllers consists of the IQ3xact with 6 inputs and 6 outputs, a basic IQ3xcite with 10 inputs and 6 outputs, and an expandable IQ3xcite which can have up to 96 points by adding DIN rail mounting I/O modules. This flexibility makes them suitable for a broad range of applications. A local PC or display (SDU-xcite) can be connected via the RS232 port.

ALLOWABLE MICROCLIMATIC VARIATIONS IN MUSEUMS AND HISTORIC BUILDINGS: REVIEWING THE GUIDELINES

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Environmental standards for cultural heritage collections have been much debated in recent years. The interest in the issue has been driven by the growing movement towards green museums, that is, managing indoor museum environments in a responsible and efficient manner, especially in terms of reducing energy consumption and carbon emissions but at the same time maintaining high standards of collection care. This paper provides a brief progression through two fundamental approaches to establish the allowable ranges of climatic variations – an analysis of the mechanical response of painted wood, the category of heritage objects most vulnerable to relative humidity and temperature fluctuations, and an analysis of the historic climate to which the objects have acclimatised. The climate specifications and standards based on both these approaches are reviewed.

THE BIZOT INITIATIVE: A DILEMMA FOR PREVENTIVE CONSERVATION?

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A group of leading museum experts, who have, under the name Bizot Group, committed themselves to the organization of large exhibitions, discovers the Green Museum! The irrefutable need to save energy and to reduce the carbon footprint shall be met by, among other measures, widening the climatic specifications for both objects on loan and in permanent exhibitions – a controversial topic even within the Bizot Group.

In the context of the recent conference Climate for Collections| Klima und Kulturgut (http://www.doernerinstitut.de/ccc_2012/de/index.html), held in Munich last November, this paper analyses the consequences of this initiative.

The consequences result in a dilemma for the preventive conservation: Is a lender opposing these requests he is considered as an anti-ecologist; comply with the request means increasing risks for the objects. Where is a way out? If Cultural Heritage is considered as a valuable resource and the up to now world wide accepted climatic guidelines as a valuable achievement, the Bizot initiative has to be rejected by lenders. In a second step, the “13 Munich Theses” enable a reevaluation of the handling of various indoor climatic data. In a third step, the need for a radical revision of museum climatisations and constructions as well as the pullout from the worldwide unrestrained commercialization and consumption of cultural assets becomes evident.

In any case, the discussion triggered by the Bizot initiative has its merits: if the aims of the initiative, against all resistance, become accepted responsible lenders will be bound to refuse loans – and each rejected loan spares resources! If the initiative fails, it will accelerate a radical revision in architecture, air conditioning technology and promote the imparting of content and thus reducing the carbon footprint. Only such a restart ensures the sustainable success of preventive conservation, a conception which seeks to cure the causes and not the symptoms.

RISK AND UNCERTAINTY: PRECAUTION AND HONESTY.

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If we are to get to the 'green museum' from where we are now, there are several choices to be made. We must choose between different approaches to balancing the demands of preservation, access and sustainability. Selecting an option relies on our ability to predict future outcomes. Prediction is notoriously difficult, and in some situations, notoriously unreliable. So we have to accept a certain degree of uncertainty in our assessment of future outcomes, and hence a degree of uncertainty about our choice of a course of action.

One approach to uncertainty is to adopt precautionary attitudes that, on the face of it, ought to be suited to conservative organisations such as museums. It is difficult to argue with "Better safe than sorry". But playing safe by ensuring stable conditions for collections may lead to sorrow as far as access and sustainability are concerned.

Individual elements in the 'green museum' mix are fairly well understood. For instance, many aspects of preservation have been studied in some detail for the last few decades. Risk assessment methodologies have been developed that ought to lead to the prediction of outcomes relating collections and their immediate environment. However, the complexity of individual objects, and the residual uncertainty in these predictions, still allows for different personal interpretations. These different individual interpretations are often vigorously defended, which can lead to distrust and poor working relations within institutions.

Distrust can lead to dishonesty. A precautionary approach may be proposed by one faction (tight environmental specifications) despite knowledge of the true susceptibility of the collections. The rationale is that 'they' will deviate from the recommendations anyway. If you offer a broader band of environmental parameters, 'they' will attempt to deviate even further.

The museum is not a group of aims and activities that run in parallel, totally unconnected. The aims and activities are irreversibly interconnected in a single system. We must move from a ‚them and us' situation. We must adopt honesty as the best policy. We must embrace uncertainty. We must recognize that the optimal choice for the museum as a whole may be sub-optimal for individual components; which may include the one we personally hold the dearest.

CLIMATIC ASPECTS FOR THE PRESERVATION OF MURAL PAINTINGS IN THE CHURCHES OF BRANDENBURG

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Because of damages to the furniture and mural paintings the climate was measured in ten churches in Brandenburg. Three of those churches are made of cobblestone, while the others are made of brick. In all of those churches the temperature was sometimes dropping below the dew point, during winter even below the freezing point, from November till May. Additionally, the relative humidity was between 40% and 100%. Temperatures below the dew point or the freezing point, and a relative humidity near 100% are more common in the cobblestone churches because of the higher heat conductivity of granite. There was only one case of condensation during the summer. This was due to bad air circulation and before the restoration. Wooden furniture needs a relative humidity between 55 and 75%, whereas mural paintings can cope with higher humidity. Though sometimes there is an algae carpet on the north wall. Humidity below 45% because of an installed heating system is much more damaging to the furniture and the murals. Flaking can be observed very often in such cases. The installation of temperature control system helps greatly to avoid damages. The most energy efficient method is a temperature control with an integrated climate measure. This allows the heating to only be active when temperatures below the dew point or the freezing point are imminent. Then the humidity is still between 40 and 85% and the year average is dropping from 75 to 70%. Crystallization of salts in the masonry and the resulting damages cannot be avoided this way.

ANALYSIS OF A SUSTAINABLE SITE SPECIFIC MUSEUM DESIGN EXPERIENCE FOR THE OPERA OF SANTA CROCE'S MUSEUM, ITALY

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This paper examines the design experience of a green temporary museum brought to light inside the multidisciplinary context of the PRIN 2007 (*Progetto di Ricerca di InteresseNazionale* – National Interest Research Project) **SiSMus** - **Site Specific Museums**. Considering the crisis of global museums and the outdated approach to museum design developed by the architects of the past century, the SiSMus workshop foresees a contemporary, socially inclusive and sustainable vision for museum centers. The relationship between the location and the project is the main target of SiSMus.

The design case study is a sustainable Welcome Point inside the *magnum claustrum* of the Santa Croce complex in Florence (Italy) that serves as new decompression space both for entering and exiting visitors.At the same times it redefines the nowadays lost original geometries of the *claustrum* and hosts new spaces for the museum's staff.Moreover the whole museum system is reconsidered with the introduction of the new structure, returning to the complex and the visitors part of the cultural heritage that went lost in time with the removal of the original structures.

The temporary welcome point of the museum is structurally independent from the ancient complex, as it can be assembled and removed in short time according to the requirements of the client. The SiSMus has been designed following the Life Cycle Design and Life Cycle Costing approaches, so it endorses the concept of sustainability: have being designed with recycled and recyclable materials and keeping in mind the reduction of the carbon burden. Indeed the structure is entirely made of dry-assemblybuilding systems and offers the possibility to install solar harvesting systemson its envelope to achieve energetic indipendence. Its building envelope is characterized by a copper surface that matures like its setting, mutating colour and aspect as time goes by.It also allows a soft natural lighting that reduces the use of artificial lighting during daytime and maximizes the internal comfort with high-performance glazings and a fully insulated copper roofing. All the ancillary concrete pre-casted elements are obtained from mixes that include minced stone scraps from local caves, reducing the costs and use of raw materials.In conclusion this sustainable architecture serves both the visitors and the museum, whilst being non-invasive and resource consuming.Furthermoreit restores the original proportions between the different parts of the complexwith a minor impact on its environmental footprint.

DUST IN MUSEUMS – NOT JUST A QUESTION OF AESTHETICS

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Dust is everywhere and it is difficult, if not impossible, to avoid. One could think of dust as inert and armless, but is that really the case? Minerals, fibers, oils, metals, etc. generate particulate matter which causes discoloration and visual noises but can also reacts chemically with objects, directly or as catalyst, increasing their deterioration rate.

Films of particulate matter make the surfaces of objects look dull and due to their hygroscopic features, can strongly bind to the surface. Constant cleaning, especially of coarse particles, has an abrasive effect.

The accumulated dust can absorb SO_2 and other gaseous pollutants. This leads to corrosion of metals and aging of other materials. Sulfur dioxide reacts with dust originating calcium sulfate which causes cracking up.

The particles which are not dangerous by their original nature may become more adhesive and harmful in the presence of carbon and organic matter. Inside the museums the reaction of the particles with gaseous pollutants especially nitrates is common.

MEASUREMENT AND ASSESSMENT OF AIR QUALITY IN THE MALEK NATIONAL LIBRARY AND MUSEUM INSTITUTION AND THE REZA ABBASI MUSEUM IN TEHRAN

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Air pollution is an important factor for the preservation of objects in the museum environment. In a 4 years project air quality is of monitored in different open and enclosed sites (such as: exhibition rooms, storage places and showcases) in various museums in Tehran, Berlin and Mumbai. The data from these museums in different climate zones will be used to assess and to compare the effects of air pollution on the museum objects. The monitored pollutants are NO_2 and SO_2, volatile organic acids and formaldehyde and O_3. This project has been implemented in collaboration between HfBK-Dresden (the University of Fine Arts-Dresden), Rathgen-Forschungslabor (Rathgen Research Laboratory) and Fraunhofer Institute for Silicate Research.

In this poster, the results of nitrogen dioxide and sulfur dioxide (outdoor pollutants) measurement in the two museums are presented. The results come from the Malek National Library and Museum Institution (MNM) and the Reza Abbasi (RAM) in Tehran. The two institutions are located in a relatively crowded and busy area in the center and north of city, respectively.

The pollutants were monitored using passive sampling tubes; the analysis in the laboratory was carried out with UV spectroscopy and ion chromatography. Furthermore, the general corrosivity of the environment was assessed by glass sensors from the Fraunhofer ISC. The corrosivity induces changes in the glass which can be determined by infrared spectroscopy (IR).

Nitrogen dioxide was measured during both summer and winter, whereas sulfur dioxide was measured only in winter. The glass sensors were exposed for 3 months, parallel to the sampling periods, temperature and relative humidity were measured using data-loggers in the showcases and exhibition halls.

The results showed that in the two museums the temperature is relatively constant, but RH% shows daily sharp fluctuations. The concentration of NO_2 is higher in winter than summer. The values range between 46-112 µg/m3 in winter and 34-64 µg/m3 in summer in the exhibition halls, storage places. The showcases had a 2-3 times lower concentration.

The concentration of SO_2 in winter was found to be between 10 and 46 µg/m3 in the museums (exhibition halls, storage places und showcases). Unlike NO_2, concentrations of SO_2 in the showcases are more or less similar to those in the rooms. This could be due to deposition of SO_2 on indoor surfaces which may considerably reduce their concentrations. However all the values exceed the maximum recommended levels for air quality in the museums. Whereas average corrosion potential based on IR extinction before and after exposure (ΔE) by the glass sensors has been determined between 0.03- 0.04 which is in the Fraunhofer ISC‘s category a low level of corrosivity. In showcases with corrosive atmosphere ΔE value of 0.7 were measured.

The results of the glass slides are somewhat contradictory to the high concentration of NO_2 and SO_2 in the museums environment. The glass slides may react stronger with organic acids, which levels have not yet been determined but are expected to be low because of the avoidance of emitting materials such as wood products in the construction of show cases. This might have lowered the corrosion potential significantly.

Considering the damages such as fading, weakening fibers and loss of the painting layers from NO_2 and SO_2, special attention must be devoted to preventive conservation, to control humidity fluctuations, air pollutants and air exchange in the museums in the frame of a general risk mitigation plan.

SUSTAINABLE VENTILATION AND COOLING OF MUSEUMS

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In most museums without air conditioning the situation often is very similar:
In those objects, which are not ventilated, often room temperature exceeds limits in summer of about 26°C which are not favorable for artifacts.

A possible solution to cool with chilling units is not the right approach because of costs of machinery and running costs, not talking about esthetic problems installing the technique.

A far better, simpler, cheaper and more sustainable solution would be to use in warm summers well filtered cold outside night air in order to pre cool at night the building masses of the showrooms to compensate accumulation of heat during next day.

Principally there are two major approaches to achieve best possible results for night cooling:

- Either one uses ventilators in windows, which are not seen from outside and well hidden from inside
- Or one uses in historic buildings existing shafts for night cooling ventilation

After having reduced external loads of sunshine by best possible shading and also internal loads by choosing light with a minimum of heat using windows for night ventilation means to choose air intake, if possible, from a northern window, leading the air with a minimal overpressure to opposite situated windows, where an exhaust fan, likewise in

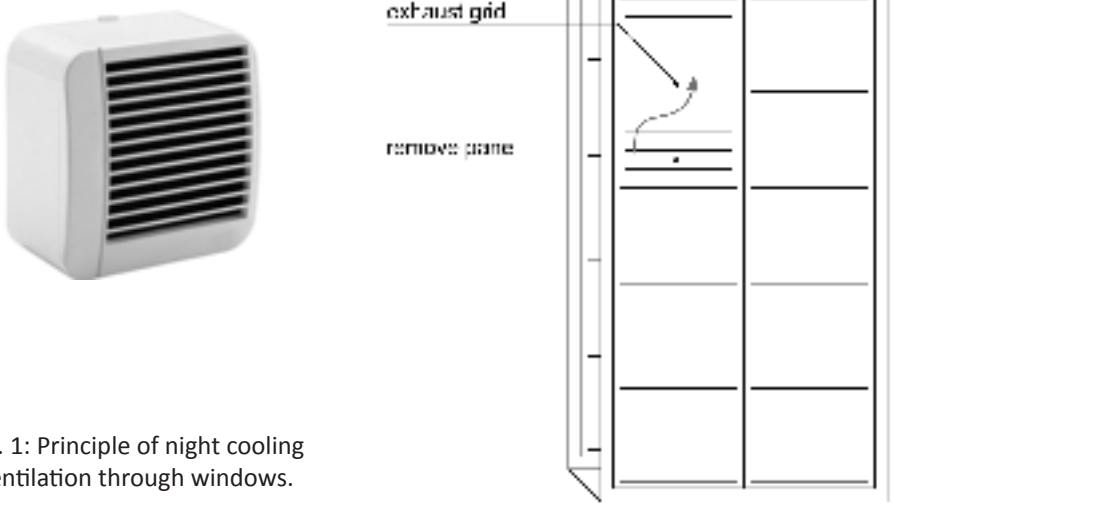


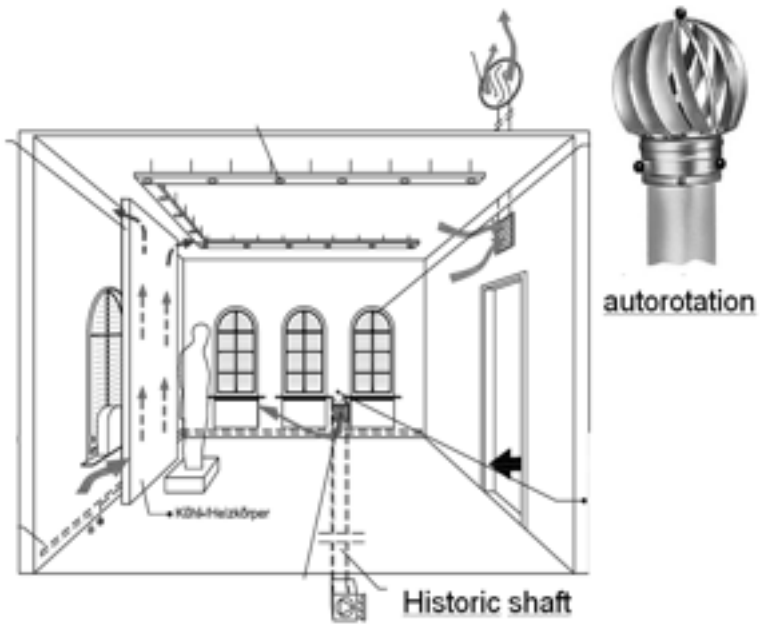
Fig. 1: Principle of night cooling ventilation through windows.

the window, will provoke at least a double air exchange rate for cooling building masses of the museum.

In the historic building of the Academy of Fine Arts, Vienna, in the south oriented “Hansen-showroom” of the famous painting gallery used to be natural ventilation through existing shafts in outer walls in which intake ventilators were installed to press filtered outside cold night air into the showroom with precious “Dürer” engravings. From this showroom another shaft exists which was used to get rid of the cooling air only by means of an autorotation ventilator, which was working on top of the shaft on the roof only by stack effect as a consequence of difference in temperature.

An intelligent control unit will start at night the ventilators by comparing absolute humidity inside and outside and also temperature in order not to bring harmful climate from outside in the showrooms.

Fig. 2: Principle of night cooling ventilation through shafts



GEORGIAN NATIONAL MUSEUM ENVIRONMENTAL MANAGEMENT AND CASE OF ORIENTAL ART COLLECTION

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Presentation will cover two main topics from Georgian National Museum experience: 1. Environmental Management through development of new regulations, 2. Conservation and re-housing of Oriental Art Collection. Preventive conservation means any measure against damage of objects and collections and reducing potential danger. It pays more attention on collections, than on certain objects. Planning preventive conservation at Georgian National Museum is a complex issue - it covers new working culture; applies new rules in museum life; arises awareness of museum personal. Besides, different types of collections need different approach, diverse methods of care. 2010- 2012 Prussian Cultural Heritage Foundation, Staatliche Museen zu Berlin and Georgian National Museum jointly implemented EU funded Twinning Project. In the framework of this project different regulatory document were developed, staff was trained, and regulations were applied in the daily work. This approach supported improvement of care of collections. In addition, concrete case of preventive conservation and re-housing of Oriental Art Collection of GNM was implemented. The Orient Art Collection (over 5.000 artworks) was exhibited and stored in 370 m^2 under unfavorable conditions (Temp: 8 °C- 29 °C and 59- 80 %RH). The valuable collection comprise of many different materials: a large carpet and textile collection; wooden objects; an Egyptian mummy case; ceramic and glass; metal objects; paintings and drawings. Integrated Pest Management (IPM) program identified six pest species: case-bearing clothes moths (Tinea pellionella) and webbing clothes moths (Tineola bisselliella), biscuit beetle (Stegobium paniceum) and the common furniture beetle (Anobium punctatum), carpet beetles (Attagenus sp. and Anthrenus sp.). To treat the infested objects was used method of Anoxia. Anoxic treatment process was divided into two stages: I stage: anoxic treatment with nitrogen (following material was processed: wood, textile, mummy, sarcophagus); II stage: anoxic treatment with argon (paintings and miniatures were processed).

ANALYSIS OF HISTORIC CARBOLINEUM TREATMENTS WITH RESPECT TO DECONTAMINATION

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The baroque epitaph Reyer (1704) at the St. Laurentius church in Tönning (Germany) was treated with carbolineum as a wood preservation agent in 1903. The subsequent constant migration of carbolineum through the layers of paint to the surface has had a detrimental on the aesthetic appearance of the epitaph.

Carbolineum is an oily, water-insoluble, flammable, dark brown mixture of coal tar components. Due to its content of polycyclic aromatic hydrocarbons (PAH), which are classified as carcinogenic and harmful to the environment, the use of carbolineum has been forbidden by the introduction of stricter environmental regulations, with few exceptions.

The aim of the project is to develop an exemplary conservation treatment that will reduce the toxic residue within the historical wooden object. The new method should be applicable to similar objects that are also contaminated with carbolineum.

An identification of the carbolineum by GC-MS method and an attempt to investigate the distribution of the material inside the artwork by neutron computed tomography (CT) were the first steps of the project.

DAILY TEMPERATURE FLUCTUATIONS CAUSED BY LIGHT SOURCES

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The reopening of the New Museum, National Museums Berlin, in 2009 involved the acquisition of several show cases for the Egyptian Museum and Papyrus Collection, and the Museum of Prehistory and Early History. Conservators of these collections and the Technical Department of the National Museum defined specifications for the microclima to have inside the show cases. Among other, it was suggested that internal light sources should not increase the temperature inside the case for more than 2 K in comparison with the surrounding temperature.

The conservator of the Egyptian Collection was concerned with daily temperature and relative humidity fluctuations inside several new cases. In this context, the Rathgen Research Laboratory measured air temperature and relative humidity inside and outside one show case; and surface temperature at different heights of a wooden polychromed sarcophagus, which was standing above the technical compartment. Climatic data was acquired during 3-5 day in the following modes: a) light and ventilation on; b) light off and ventilation on; c) light and ventilation off.

Results showed that the light source was influencing the indoor climate of the case. Surface temperature fluctuations of the wooden object decreased with increasing distance to the light source: at the floor level 5 K and at a height of 110 cm 0,5 K (average values). These daily fluctuations were caused by the waste heat (radiant and conductive) of a metal-halide projector (SCHOTT SpectraNova™ Lightsource 150SEF/SES). The technical compartment, which was placed under the floor of the case, was climatically separated from the case interior. However the technical compartment was located so close to the case floor that the distance between them did not allow to install enough isolation layers.

As the daily temperature fluctuations inside the case were not acceptable for keeping objects sensitive to humidity changes, it was suggested to change the light source. A LED projector was installed (SCHOTT Spectra™ Lightsource 100 W) in several show cases. The LED projector emits less waste heat, with surface temperature fluctuations at the floor above the technical compartment within 3K in average. Even though the new light source still does not meet the temperature specification, this study helped in the decision taking process and estimation of risks for the wooden collection displayed in the new show cases.

TEMPERIERUNG AS A TOOL FOR PREVENTIVE CONSERVATION – AN ASSESSMENT

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The research project *'Temperierung' as a Tool for Preventive Conservation – An Assessment* is based on a close and interdisciplinary collaboration between building physicists, conservators and 17 selected museums in Bavaria, under the lead of 'Landesstelle für die nichtstaatlichen Museen in Bayern' (State office for non-state museums in Bavaria). All participating museums have been equipped with a 'Temperierung' heating system between 1987 and 2011. The impacts of these 'Temperierung' heating systems on the buildings and on the collections will be assessed within the project.

The Temperierung was mainly developed by the 'Landesstelle'. It is recommended as a heating and climatization system for enhanced climate stability in museum buildings.

The impacts of this empirically developed system on the buildings, the indoor climate and the collection have not been subject of a systematic scientific investigation yet. Within the project different types of Temperierung systems in different buildings and climate zones in Bavaria are examined. On the one hand, the influence of the Temperierung systems on building components and indoor climate are investigated and assessed from the building physics point of view. On the other hand, the assessment of the impact from the indoor climate generated by the different Temperierung systems on the preservation of the collections is the subject of the conservator's examination.

The intention of the investigations is a collection based study of the effects from the different indoor climates influenced by Temperierung on the works of art. Criteria for choosing single artifacts are – besides their material – the extent and quality of existing documentations and the duration of the exposition towards a climate created by a Temperierung system. Changes of the state of preservation within a provable time span should be reproducible documented and evaluated. With statistical methods possible relations between the preservation of the artifacts, indoor climate, quality of the building envelope, Temperierung system, visitors, museum use and maintenance are investigated.

The individual modes of Temperierung in the museums and their effects on building components and indoor climate are systematically measured and evaluated. One of the priorities is to measure the energy consumption of different heating system installations and mounting positions in selected facilities of four focus-museums. Accompanying this, computer simulations are performed to show the influence of Temperierung systems to building components and indoor climate and to further enhance existing models of the hygrothermal processes. The measured data are also used as boundary conditions for building simulation.

The project will offer valuable clues towards the in the past controversial discussed effects of Temperierung systems to building components, building, indoor climate and exhibits. The goal is a science-based, neutral processing of current knowledge and the creation of new knowledge, with the help of detailed building physical measurements and conservation research of the collections on site. With this work, the Temperierung systems will be developed further in terms of their operation as well as energy consumption – for the improved preservation of buildings and collections in the future.

MEASUREMENT OF AIR POLLUTANTS IN SHOWCASES BY PROTON TRANSFER REACTION MASS SPECTROMETRY

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The *Neues Museum* on the Museum Island in Berlin was restored and reopened in 2009. Although all new showcases were made from Oddy-tested materials, a large number of the newly fitted showcases were tested for air quality. Proton Transfer Reaction Mass Spectrometry (PTR-MS) is a new approach which offers the possibly to carry out real-time monitoring measurements of air pollutants directly at atmospheric pressure. The showcase does not need to be opened entirely as the air is sampled by a capillary which can enter the interior of the showcase via a small interstice.

The PTR-MS had been calibrated prior to the measurement for a number of compounds: *i*-propanol (IPA), acetone, acetic acid, xylene and toluene. Sample flow taken from the showcases was set to 500 ml/min of which 5 ml/min were injected continuously into the ionization chamber of the MS.

The study had three main aims: First, apply PTR-MS for the first time to the measurement of showcases; second, to evaluate if the concentration of acetic acid complied with the 10 years preservation target level of 100 µg/m³, commonly used as a standard for permanent storage; third, screening and comparing the air inside cases of different makings / with different objects.

Each group of showcases displayed a different “fingerprint” of concentrations depending on the materials used for its construction, furnishing and displayed objects. In most showcases acetic acid and acetone were the compounds with the highest concentrations. The highest levels for all five measured compounds were found in temporary showcases made from MDF.

The showcases analysed in this study can be divided into four groups corresponding to their construction materials. For permanent display cases were made from metal, the interior being either Corian® (a material composed of an acrylic polymer and aluminium hydroxide) or concrete. Some showcases for temporary display were made from wooden construction material i.e. medium-density fiberboard (MDF). The historic showcases were made from massive wood (lacquered). All panes of the cases were made from glass.

By PTR-MS 38 showcases were analyzed within two days. The 10 years preservation target level for acetic acid was not met by all showcases. The temporary cases made from MDF showed the highest levels for this compound, closely followed by the historic wooden cases, which did exceed by far the recommended target level. The showcases made from metal and Corian were sometimes above this level; here internal sources from the case seem to play a role. Corian itself seems not to be the cause but there is evidence that some the other constructing materials were not Oddy tested. The showcases made from metal frames with concrete interior were well below the target level.

TECHNICAL SPECIFICATIONS OF SHOWCASES AT THE NATIONAL MUSEUMS BERLIN: THEORY AND PRAXIS

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The National Museums Berlin have revised the paper which is fixing the technical specifications and requirements for new showcases to be acquired by the museums. Experiences of the Rathgen Research Laboratory made by the assessment of cases with analytical methods were incorporated in the paper. Measurements were carried out mainly in new cases for permanent display, but also temporary and historic cases have been studied. Preventive conservation aspects of the technical specifications such as material testing, measurement of air pollutants, recommendations for light sources regarding the light induced heat, colour rendering index and the damage potential as well as air exchange rate are concerned.

We believe that our technical specifications for new showcases have improved by including the experience made with showcases in life praxis. In this process the knowledge from the praxis was taken to the theoretical level of a specification.

MARGRAVIAL OPERA HOUSE IN BAYREUTH - CONCEPTS AND PLANNING FOR INDOOR CLIMATE IN THE FRAME OF A MAJOR CONSERVATION AND BUILDING MEASURE

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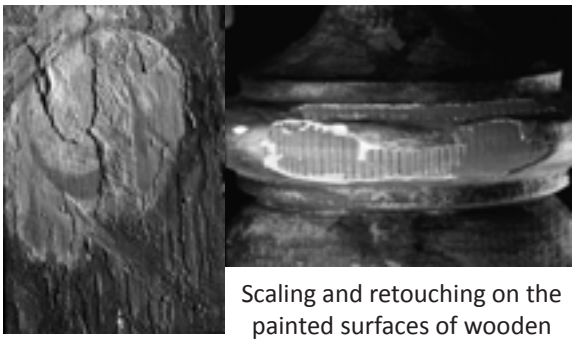
The history of the Margravian Opera House includes the history of the ways in which it has been heated and thus the air conditions prevailing in it. No less than twelve different heating systems have been successively installed and removed since the eighteenth century. Some were only used for a short period, as they proved to be too expensive or inefficient or caused damage to the valuable decoration of the auditorium (the loge hall).

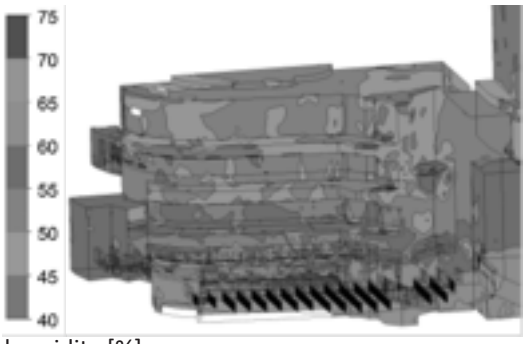
A desire to make performances possible in the Opera House all year round, along with faith in modern air-conditioning technology, led to a large air-conditioning system being installed during the 1970s, with the required inflow and outflow ducts. Considerable damage (flaking) and losses (scaling) on the painted surfaces and gilding, as well as cracks and warping in the wooden and textile support materials, occurred in the years that followed. Inadequate restoration work made the situation worse.

The conspicuous damage – as well as clear criticism by representatives of historic monument preservation bodies of the intensive usage of the sensitive building – led to the collection of extensive serial measurement data and 'damage monitoring'. It emerged that – particularly in connection with events held during the winter season – the relative humidity often fell to below 40% (with warming and cooling of the enclosing walls). Due to inadequate or incorrect adjustment and control of the air-conditioning system, changes in the air conditions were also taking place frequently, which the historic substance was not capable of adapting to.



Scaling and retouching on the painted surfaces of wooden supports (photos: M. Staschull, 1995)

Lengthy discussions and reviews led to the decision being taken to limit the usage of the Margravian Opera House, and plans were approved for a complete restoration of the building. The most important aspect of the restoration plan involves achieving reliable control of air conditions in the loge hall. In the view of the engineers, the air-conditioning technology needed meets all requirements relating to reliability and safety. The relevant parameters have been calculated using a simulation model.



Simulation model of expected humidity values in the auditorium (source: H. Post, b+e Ingenieurbüro, 'Short Report on Air Flow Simulation', 25 April 2012). Apart from the areas marked in red (representing spotlights and beamers), the relative humidity should no longer fall below 40% with the new air-conditioning system.

III: THE ECONOMIC AND ECOLOGIC DIMENSION

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CARBON FOOTPRINTING MUSEUM LOANS: TOOLS AND FINDINGS

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While museums aim to lessen their impact on the environment, they also face growing demands to increase collections mobility at national and European levels. Meanwhile, exhibition budgets everywhere are being slashed. How can museums balance the environmental impact with the social and economic benefits from lending collections? By using a newly developed carbon footprinting methodology, museum staff can manage the impact of their loan programs on climate change by benchmarking their performance and setting internal emissions reduction targets. A performance indicator for the *Environmental Impact of Loans* (EIL) is introduced; this metric encourages museums to offset the environmental with the social and economic benefits of exhibitions so that improvements are not proposed simply by scaling down activity. This triple-bottom-line approach ensures that organisations such as museums can demonstrate a sincere commitment to improving environmental performance without inviting fundamental criticism of the use of energy for heritage activities. The carbon footprinting methodology for loans was developed using activity data from the Art Department of Amgueddfa Cymru – National Museum Wales. Based on this experience a series of evidence-based recommendations are proposed.

SAVING ENERGY IN THE NATIONAL MUSEUM IN KRAKOW, POLAND – A CASE OF GREEN CLIMATE MANAGEMENT

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Monitoring the energy consumption over a full year in the Main Building of the National Museum in Krakow, Poland has allowed energy performance of several climate-control operations - ventilating, heating, cooling, humidifying, dehumidifying – to be determined quantitatively and used in the assessment of current museum's strategy for indoor climate management. The assessment was further refined with the help of computer modelling which simulated the energy demand for different climate control scenarios using the WUFI PLUS software. The simulation has revealed the crucial importance of limiting the ventilation rate, which reduces very significantly energy needed to condition the air. To further reduce the energy demand, extending the allowable relative humidity (RH) range is proposed while maintaining safe conditions for the collections. Especially, an appropriate humidification reducing magnitudes of winter drops in RH should be a priority measure improving radically the collection care at low cost. The study provides a tool for comparing different strategies of climate control and building management in museums so that the desirability of long-term preservation of the collection is optimally reconciled with the need to control the economic and ecological costs.

The outcome of investigations performed has supported reviewing of Museum's policy and practice regarding climate control. The modified approach to the climate control was first applied during comprehensive rebuilding and renovation of the historic seat of the Princes Czartoryski Museum in Krakow, started in 2010.

III: THE ECONOMIC AND ECOLOGIC DIMENSION

THE CURRENT TREND OF GREEN MUSEUM IN JAPAN

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It is reported that the global warming is accelerated by the increase of carbon dioxide in the atmosphere and this causes various problems in our society. In Japan, the reduction of the carbon dioxide release was demanded in various kinds of building including museum buildings. Various kinds of efforts were made to reduce the amount of electricity used in museums to meet the demands. The promotion of Sustainable Building is increasingly important in the building sector. To carry this requirement into practice, this movement is now progressing through the use of CASBEE (Comprehensive Assessment System Building Environmental Efficiency) as the core strategy of Ministry of Land, Infrastructure and Transportation (MLIT) in the same way with LEED (Leadership in Energy & Environmental Design) program in the USA.

Here, I will report several examples of sustainable museum buildings considering the museum environment in Japan. One example is the Nezu Museum in Tokyo. The Nezu Museum is an art museum with a beautiful Japanese garden. To improve the storage environment, it was decided to renovate the museum for three years and half from 2006. The following three subjects were investigated to get good environmental control for the storage facilities. 1. Insulation method using existing structure, 2. Climate control system that would control the heat and humidity within the storage facilities, 3. Airflow environment within the storage facilities. For these investigations, three dimensional air flow and heat flow simulations were carried out to obtain energy sufficient system. In addition, to reduce the energy for lighting, LEDs (light emitting diodes) were used for display lights instead of fluorescent lights in the exhibition rooms.

The great east Japan earthquake occurred in March 11, 2011. The nuclear power plant in Fukushima Prefecture was damaged by the huge Tsunami. There 54 nuclear power plant in Japan. Now only one nuclear power plant is in operation and the rest 53 plants are not. Because of this situation museums in Kanto region including Tokyo was asked 15 % reduction of peak value of electricity in daytime from the government in 2011 summer time. To cope with this demand, museums tries to reduce the amount of electricity used in the building in various ways. For example, Tokyo National Museum decided to stop the air conditioning system of storage rooms in daytime and operate it in nighttime and succeeded to get 15% peak reduction of electricity at daytime with keeping good storage environment.

In this report, various kinds of efforts to try to achieve green museum in Japan will be shown.

SUSTAINABLE CLIMATE CONTROL IN MUSEUMS – PRESERVATION AND ECONOMICS

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The heavier demands that society now places on the efficient management of finite resources in general and energy in particular is bound to have consequences for our ability to use and preserve the built cultural heritage. A sustainable use and preservation of the cultural heritage requires broad and long term compromises between social, economic and environmental aspects, understanding that they are mutually dependent rather than isolated quantities.

Control of indoor climate in museums an issue that brings the trade-off between the different aspects of sustainability to a head. The cultural heritage items can be seen as a non-renewable national resource that demands efficient and careful management with a long time perspective. On the other hand we have to consider the costs, in economic and environmental terms, of climate control. Specifications and technical solutions for indoor climate in museums have received a lot of attention. However the economic aspect of sustainability is often assumed implicit or excluded from the discussion.

The proposed paper has the following objectives:
The first objective of the proposed paper is to show how the relationship between climate control and costs can be described. Based on case studies it will be shown how both investments and operational costs depend on requirements of climate control.

The second objective is to discuss if and how the preservation of the cultural heritage can be described in economic terms in order facilitate better decision making at both operational and policy levels. Can loss of value be described in economic terms. Can conservations costs, in relation to indoor climate, be systematically accounted for? What can we learn from the methodology of natural conservation?

III: THE ECONOMIC AND ECOLOGIC DIMENSION

IDENTIFICATION OF PESTICIDES IN ETHNOGRAPHIC COLLECTIONS. AN ARGENTINIAN-GERMAN CASE STUDY.

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The research and evaluation of the conservation state of a Chamacoco outfit from Paraguay at the Museo Nacional del Hombre of the Instituto Nacional de Antropología y Pensamiento Latinoamericano (MNH - INAPL) was triggered within the global plan of preventive conservation of this institution. This plan aims at establishing priorities in the management of the collections forming part of the MNH. The INAPL was conceived in 1943 in Argentina as a research institution. The MNH forms part of the INAPL, and its collections amount to 5.000 ethnographic, archaeological and folklore objects from Argentina and surrounding countries. The biggest part of the collection is currently in storage.

The outfit subject of this work is of high symbolic value and consists of two coronets or vinchas made of a chaguar or caraguatá braid, parrot feathers and peccary bristles; a collar made of seed and animal teeth presumably belonging to one of the coronets; a cord collar made of caraguatá fiber and feathers (parrot, birds of prey) provided with a whistle; and wristbands.

Initial analysis carried out at MNH allowed the detection of white residues in the pieces. Suspecting a health hazard given the partially known history of the group, first samples for analyses were taken. Spot tests of the crystals, carried out in the laboratory of Taller Tarea, UNSAM (Argentinien), were negative for nitrates, nitrites, sulfates and chlorides. Further tests allowed excluding fungi metabolite products as a possible origin of the efflorescences. Energy-dispersive X-ray spectroscopy (EDS) analyses confirmed the presence of chlorine in some of the samples, pointing at the possibility that a chlorinated pesticide was present. Given the health threat these compounds pose to staff working with museum objects, it was mandatory to be able to confirm or refute their presence. With this purpose, new samples were taken and analysed in the Rathgen Research Laboratory of the National Museums Berlin.

The pieces were examined again for efflorescences and other powder or crystalline residues. A total of 10 samples were taken, both with crystalline appearance as well as incrustrations, and analysed with Fourier-Transform Infrared Spectroscopy (FTIR). Among the crystalline samples, the one taken from the collar showed to contain the insecticide p,p'-(dimethoxydiphenyl)trichloroethane (DMDT), also known as methoxychlor. Methoxychlor, a structural analog of DDT, was developed as a replacement for this pesticide but was eventually banned in the US and EU. It has been used to control cockroaches, mosquitoes and flies among others, as well as various arthropods that attack ornamentals and domestic pets. It was therefore available as an over-the counter product marketed in a range of formulations, including dusts and ready-to-use liquids products.

GARBAGE IN THE CONTEXT OF CULTURAL HERITAGE

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EMAIL

Many important historic cities are in danger of terminal obsolescence. Fine traditional environments such as Old Cairo, is one of the examples of important historic areas that now demonstrate the characteristics of slums which is one of the most important issue in 21st century. This phenomena is growing fast specially in mega cities like Cairo. Slum area in this city divided to three main types that Mansheyat Nasser is known as the largest one where contain three zones with historical background: city of Death, Mansheyat Nasser and Mokattam.

Mokattam area is surrounded by Mokattam cliffs and other neighborhoods. Since 1940s everything in this part of the city spin around garbage that highly influence in urban structure and architecture. They manage the most efficient solid waste management in the world with efficiency up to 80 percentage. The identity of this area is the garbage as common object. People collect, transport, sort and recycle close to half of whole garbage that produce every day by Cairo householders. This society is called Zabbaleen “garbage collectors” who mostly are Christians of ancient Coptic Church. Inside this society there are several cave churches but the biggest one was built in 1975 after a large fire in Manshiyat Naser. The Monastery of St. Simon the Tanneris the largest church in middle east with capacity 20,000 in 1000 square meter. After establishment of this church Zabbaleen felt more secure and start to use more permanent building material such stone and bricks instead of tin huts. The cave churches of Mokattam are also a point of interest for many tourists visiting Cairo and has specific affect on people.

Accordingly to all Mokattam play an important role in Cairo not only as garbage village but as cultural heritage which should be concern that how we can improve the life situation beside the preservation of their cultural heritage and using the ecological energy and resources.

PESTICIDE CONTAMINATION AND CULTURAL HERITAGE

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The current trends in climate control in museums oscillate between the usual standards of 50 ± 5 % RH / 20 ± 2 °C and the new paradigm of the Green Museum. The balance between acceptable humidity and temperature levels for works of art and the economic costs this brings with it is a present field of debate, as evidenced, among others by the topic of this workshop.

However, other factors may need to be included in the discussion, especially when looking for a compromise between air exchange rates and economic viability.

The concentration of pollutants such as pesticides, whether in air or in dust, has implications regarding the health and safety of staff and scholars with access to objects and depots in museums. An acute case is that of buildings of historical significance where pesticides were used in the wooden structures, and where modification of the structures is regulated by Heritage Property legislation.

The present poster discusses typical pesticides and their occurrence in museum and buildings of cultural or historical significance, in the context of the legislation regulating levels over which treatment is mandatory. The rationale behind meaningful sampling and analysis strategies will be succinctly exposed.

The current trends aiming at adjusting levels to legal standards, including ventilation cycles and use of adsorbing textiles, will also be shortly reviewed, with a special focus on feasible strategies for large institutions.

The development of strategies aimed at mitigating health risks necessarily falls down into at least one of the following categories: reduce or remove the hazard or lower one‘s exposure to it.

WITHOUT BIO"GREEN" IN *GREEN* MUSEUM – ECO-FRIENDLY MUSEUM PEST CONTROL

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The concept of an Integrated Pest Management (IPM) in crop protection was developed in the 1950's to find easier, less costly and more reliable measures to avoid, block, detect, identify and treat occurring pests. In agriculture, IPM decisions are made economically and deduced from certain threshold levels. More and more IPM is introduced for cultural heritage protection as well to minimize biodegradation of museum objects. IPM's holistic approach and improved strategy can solve issues of biogenous damages in museums and historic buildings in a pesticide free, environmentally compatible way and with a sophisticated resources use.

Living organisms recycle material since hundreds of million years and impressive adaptations evolved. Museum collections shall be out of this run. Therefore, a thigh storage, quarantine, an appropriate - pest discouraging - climate control and good monitoring are essential. Any infestation should be identified to proceed suitable treatments, saving time and energy.

GREEN MUSEUMS IN THE SECONDARY SCHOOLS OF SPAIN

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This abstract aims to illustrate these Green Educational Museums that are scattered around the Spanish geography. The images collected models, books, scientific, botanical elements, vertebrates and invertebrates and a set of cultural goods that configure these scientific collections.

The poster, with good photographic images, is supplemented by a selected bibliography, for anyone interested in the subject.

This poster will be made by the Group S.O.S. Heritage (HUM 673), University of Sevilla. This is a research group dedicated to helping society by providing the services of Cataloging, Conservation and Restoration. The US-IES project is a group project to support the Institute St. Isidore of Seville, who has begun a course of Preventive Conservation applied to scientific collections. But the Institute St. Isidore of Seville is one example of many that exist in the Spanish territory.

These historical collections have been formed over time thanks to the provision by the Ministry of Education of cultural goods that have served and are serving to teach and show young people the natural and cultural heritage, illustrating the theoretical courses secondary. These collections are now museums truly green, as they are composed of cultural property originating from the Natural Sciences, Physics, Chemistry, objects and scientific instruments, with representatives of all the elements of nature, sometimes even with botanical gardens. These collections are classify, sorted and displayed, and used for educational proposes to young students, and today constitute a great attraction for the whole society, which can be seen in them, a clear reflection of the House of Knowledge, that is, a microcosm in the that reflected the natural and cultural world through beautiful models, physics and chemistry laboratories or cabinet of Natural Sciences.

Some Institutes also have historic buildings, which show their collections. They also have a real bibliographic and documentary Heritage that is closely related to the building and the collection, forming in some cases, an archive, a library and a museum. The purpose of these collections is to support education, and they are a real master class on the sustainability of Natural and Cultural Heritage that should be preserved and transmitted, by themselves constitute, Green Museums.

Their study and appreciation involves a challenge to Spanish society. They have been preserved thanks to the patient and selfless work of secondary teachers and in some communities have made agreements with the universities for study, cataloging, restoration and maintenance.

Maybe it's time to raise a joint custody, support this effort, with new projects to help its restoration, to improve their display systems and complete these old collections, with new educational media following the development of new technologies with creating virtual museums accessible to everyone.

ANALYTICAL METHODS TO DETERMINE WOOD PROTECTIVE AGENTS

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Since more than 150 years wood protection agents have been used in buildings. Pentachlorophenol (PCP) was the most used fungicide for wood protection in the last century, often in combination with the insecticide lindane (γ-Hexachlorcyclohexan). The use of these substances has been forbidden in Germany since 1989 [1]. The emissions of pentachlorophenol and lindane can affect the indoor air quality also years after the application; this can be a risk to human health. In the World Heritage Site church in *Świdnica* in Poland, completely made of wood, wood protection substance (Xylamon) was used in the last century. The analysis of wood protection agents and volatile organic compounds of these treatments were performed in different steps by the Federal Institute for Materials Research and Testing, Department 4, "Materials and Environment".

First on-site measurements on wood were done by X-ray fluorescence analysis (XRF). In this study we used the handheld XRF spectrometer TRACER III-SD (Bruker AXS Microanalysis GmbH) with a 4-mm measurement spot. All measurements were conducted with a 1-W low-power rhodium tube, excitation parameters were 15 KV and 55 µA for the determination of chlorine. In a second step wood samples (10-100 mg) were investigated in a micro chamber (µ-CTE) at different temperatures and analysed by GC-MS-MS to detect substances in the wood. In the next step, VOC sampling was carried out using Tenax TA tubes with followed by thermal desorption and GC-MS analysis. The sampling volume was 20-25 l with an air flow of 200 ml/min. Quantification was carried out using internal standards. Finally, dust samples were analyzed as a possible carrier of substances from the treated wood into the indoor air. After extraction with acetone the samples were analysed by GC-MS. The dust was also investigated by EDX-analysis to identify the PCP containing particles.

In all samples pentachlorophenol and lindane could be detected either quantitatively or qualitatively.

[1] R. Bessing, R. Derra, *Holzschutzmittelbelasungen durch Pentachlorphenol und Lindan in Wohn- und Aufenthaltsräumen*, Staub – Reinhaltung der Luft, 1992, **52,** 265-27.

DOMESTIC SERVICE AND PREVENTIVE CONSERVATION

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The purpose of this paper is to identify where the practices and patterns of employment in contemporary preventive conservation have developed in a similar way to historic domestic service and to demonstrate the advantages of resurrecting some historic practices in the interest of sustainable development. There are several parallels between modern museums and historic country houses in the roles, customs and hierarchies of servants and conservators. These include the importance of housekeeping routines in preventive conservation as well as the hidden, almost invisible nature of both professions. Energy efficiency and sustainability in preventive conservation could more easily be achieved by following some of the traditional methods and materials, which maintained stable environments for objects in country houses for many generations. Some institutions are beginning to follow this course and have found that it has benefits for sustainability, finance and visitors.

III: THE ECONOMIC AND ECOLOGIC DIMENSION

ARCHAEOLOGY TODAY AND TOMORROW – SCIENTIFIC AND MUSEUM WORK ON ARCHAEOLOGICAL FINDS FACING BIG CONSTRUCTION PROJECTS ON LAND AND SEA

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Public authorities for the protection of monuments and further cultural institutions fall on hard times to preserve archaeological monuments in times of social, political and economic changes. Large-scale projects for the expansion of road and railway networks, structural concentrations in urban agglomerations lead to numerous anticipative rescue excavations. Especially the energy turnaround will cause many constructions of offshore wind energy plants and energy lines. Energy politics are pushing this transition project forth with high priority thus archaeological remains underwater and underground are endangered of irretrievable destruction. As part of the EU Water Framework Directive from 2000 a high number of hydraulic-engineering operations are commenced in Germany since 2009 interfering in many places also with archaeological monuments. The deepening of the Elbe undertaken at several places since the 19th century is increasing today in consequence of the enormous intensification of merchant and industrial shipping. In some cases archaeology can benefit from environmental protection but more and more archaeologically relevant sites are affected by hydraulic-engineering measures for fairway deepening.

Despite of the difficult working conditions and time pressure rescue excavations have brought numerous spectacular finds to light which could be conserved and prepared for public presentation with grants by financial supporters. But these cases are exceptional. The scientific and public exploitation of archaeological finds salvaged from rescue excavations are still causing more problems than knowledge. The lack of storage capacities, of human and financial resources is omnipresent. A sustainable cultural heritage care rely therefore on the development of new preservation strategies, enabling scientists and conservators to preserve, research and display objects and results for public's benefit.

Under the aegis of German Maritime Museum (DSM Bremerhaven) and Fraunhofer-Institute for Building Physics (Fraunhofer-IBP) a group of conservators, archaeologists and engineers is developing a holistic process consisting of conservational first-aid measures, chemical conservation treatments for stabilization and long-term storage of wet organical and metallic objects, embraced by a system for archaeological, conservational and logistical management of the inventory. An important and basic tool is the use of modifiable ISO CA-Container (**A**droit **R**escue **C**ontainer for **C**ultural **He**ritage, AR**C**He). They can be used for salvage, storage and transport of archaeological finds but also as mobile laboratories at the scene of occurrence.

A first pilot project is taking place in Lübeck, where an excavation in the founding area of the city (UNESCO world heritage site) has brought to light one of the earliest wooden cellar constructions from the Middle Ages.

Further researches are run for the optimization of conservation processes and for energy-self-sufficient container systems to keep our solutions economically and ecologically affordable. However an important thing is to transfer knowledge from research to market by a spin-off. Reasonable solutions must be made available as services for cultural heritage offices and museums. This is a flexible, universal, reliable and economic way to preserve our common cultural heritage and to establish a tower for all cultural institutions suffering from declining culture budgets and increasing pressure.

NATIONAL MUSEUMS BERLIN

ON THE MUSEUM ISLAND

ALTE NATIONALGALERIE
A Temple to the Art of the Nineteenth Century

Today, the Old National Gallery (Alte Nationalgalerie) is home to 19th century sculptures and paintings. It came into being in 1861, when the banker J.H.W. Wagener bequeathed his art collection to the king and a new building was erected to house it. Having suffered severe damage during the Second World War, the Old National Gallery was partially re-opened in 1949, and in 1955 all of its rooms were once more accessible to the public. Due to the Masterplan Museum Island, which enabled the gallery‘s comprehensive restoration from 1998, it re-opened in December 2001 as the first restored building on the Museum Island. Together with Altes Museum, the Bode Museum (re-opened in October 2006), Neues Museum (re-opening 2009) and the Pergamon Museum, it belongs to the ensemble of Berlin‘s Museum Island which was listed as UNESCO World Cultural Heritage in 1999 and ranks among the most splendid highlights of the Berlin museum landscape.

The collection
The Alte Nationalgalerie, home of 19th century art, forms one of the five columns of the National Gallery. The remaining four are the Neue Nationalgalerie (New National Gallery) with art of the 20th century, the Museum Berggruen with works of early 20th century modernism, the Hamburger Bahnhof - Museum für Gegenwart - Berlin with contemporary art, and Friedrichswerdersche Kirche (Friedrichswerder Church) with 19th century sculptures. The Alte Nationalgalerie is regarded as a comprehensive collection of art of the era between the French Revolution and the First World War, between Classicism and Secessions. The harmonious relationship between the museum building and its collection is unique: designed under the auspices of Heinrich Strack according to plans by August Stüler, the gallery was built in the years 1867 to 1876: the collection it houses today, one of the most beautiful of its kind, originates from the same century. Hence, a tour through the museum offers a profound insight into the art of the 19th century.

3rd floor exhibition
The art of the Goethe era is represented with landscapes by Jakob Philipp Hackert, portraits by Anton Graff and his contemporaries and works of the German artists working in Rome, known as the Nazarenes: Peter Cornelius, Friedrich Overbeck, Wilhelm Schadow and Philipp Veit. Their frescoes illustrating the story of Joseph, commissioned for the Casa Bartholdy in Rome, constitute a major achievement of the period.
Two rooms on the top floor of the Alte Nationalgalerie offer space for the jewels of Romanticism. Paintings by Caspar David Friedrich from all phases of his artistic career illustrate the development of the great master of German Romantic art. Karl Friedrich Schinkel‘s programmatic architectural visions are evidence of the architect‘s ingeniousness as a landscape painter. Another focus is formed by the works of Carl Blechen, whose vibrant colours and unconventional motifs are ahead of their time. Moreover, on display are portraits by Philipp Otto Runge and Gottlieb Schick, as well as landscapes by Joseph Anton Koch and Carl Rottmann. Biedermeier art is represented with Berlin views by Eduard Gaertner and Johann Erdmann Hummel, as well as with landscapes, genre paintings and

portraits by Carl Spitzweg, Ferdinand Georg Waldmüller and others.

2nd floor exhibition

The collection also contains rich holdings of high quality Impressionist painting. Masterpieces by Edouard Manet, Claude Monet, Auguste Renoir, Edgar Degas, Paul Cézanne and sculptures by Auguste Rodin were purchased at an early date.
Painting of the second half of the 19th century is abundantly represented with works by Hans Thoma, Anselm Feuerbach, Arnold Böcklin, Hans von Marées, Wilhelm Leibl and Wilhelm Trübner. Further, the Alte Nationalgalerie presents its large collection of paintings by Max Liebermann.

1st floor exhibition

Adolph Menzel's paintings, among them such important works as „The Balcony Room" and the „Iron Rolling Mill", reveal the artist as an unremitting observer who, picking up important subjects of Prussian history, simultaneously displays stupendous imagination and a fine sense of colouring.
Among the 19th century sculptures are such famous works as the two princesses by Johann Gottfried Schadow as well as works by Berthel Thorwaldsen, Antonio Canova, Ridolfo Schadow, Reinhold Begas, Adolf von Hildebrand and Constantin Meunier. Further sculptures of the Schinkel era are on display in Friedrichswerder Church.

Adress

Bodestraße 1-3, 10178 Berlin

Museum entrance

Am Lustgarten

Opening hours

Tuesday – Sunday
10:00 am – 06:00 pm

Public transport

S/U-Bahn
S/U-Bhf. Friedrichstraße S1, S2, S25, U6
S-Bhf. Hackescher Markt S3, S5, S7, S75
Tram
Hackescher Markt M4, M5, M6
Am Kupfergraben M1, 12
Bus
Friedrichstraße 147
Lustgarten 100, 200
Staatsoper TXL

NATIONAL MUSEUMS BERLIN

ALTES MUSEUM

The Altes Museum, built by Karl Friedrich Schinkel between 1823 and 1830, is one of the most important works of neoclassical architecture in the world. The monumental arrangement of its 18 fluted columns, the huge expanse of the atrium, the staircase and rotunda, lined with an array of ancient sculptures, male it a place for reflection and a clear homage to the Pantheon in Rome. Such architectural features had, until then, only been reserved for rulers' palaces. The inscription over the portico reads: 'Frederick William III has dedicated this museum to the study of all antiquities and the free arts, 1828'.

Today the museum houses the Collection of Classical Antiquities, showcasing its permanent exhibition 'ANCIENT WORLDS. Greeks, Etruscans and Romans in the Altes Museum' over two large exhibition floors. The Numismatic Collection, also part of the National Museums in Berlin, complements this sweeping overview of classical antiquity with its display of ancient coins.

Collection of Classical Antiquities and Numismatic Collection

The Berlin Collection of Classical Antiquities boasts a proud history of more than 350 years. It is now on show at three separate venues: on all floors of the Altes Museum, the Neues Museum (with the archaeology of Cyprus and the Roman provinces) and the Pergamonmuseum, with its three world-famous halls of ancient architecture. The Altes Museum is again now entirely dedicated to classical antiquity. Its main floor provides an impressive panorama of the art of ancient Greece from the 10th to 1st century BC. The chronologically divided tour through the show contains stone sculptures, vases, craft objects and jewellery in a richly diverse exhibition, structured around certain core themes. Highlights include the statue of the 'Berlin Goddess', the 'Praying Boy', the 'Amphora of the Berlin painter' and the 'Enthroned Goddess from Taranto'. Jewellery made of gold and silver, as well as gemstones spread out to form a veritable treasure chamber beneath a blue firmament.

Integrated into the show is a display by the Numismatic Collection, presenting a selection of its finest pieces of ancient mintage. They range from the earliest coins from the 7th century BC made of electrum (an alloy of gold and silver), up to coins from the Roman Empire's crisis years in the late 3rd century AD. The more than 1300 exhibited coins form a body of ancient original artefacts to be admired within themselves that also impressively correspond to the ancient art on display. On the upper floor, the art and archaeology of the Etruscans and the Roman Empire are on view. As one of the largest collections of Etruscan art anywhere in the world outside Italy, it contains such famous works as the house-shaped urn from Chiusi and the clay tablet from Capua with a large Etruscan inscription. The collection of Roman art, meanwhile, unveils precious artefacts such as the Hildesheim silver find and portraits of Caesar and Cleopatra.

Adress
Bodestraße 1-3, 10178 Berlin

Museum entrance
Am Lustgarten

Opening hours
Tuesday – Sunday
10:00 am – 06:00 pm

Public transport
S/U-Bahn
S/U-Bhf. Friedrichstraße S1, S2, S25, U6
S-Bhf. Hackescher Markt S3, S5, S7, S75
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Am Kupfergraben M1, 12
Bus
Friedrichstraße 147
Lustgarten 100, 200
Staatsoper TXL

BODE-MUSEUM

The Bode-Museum was originally built from 1897 to 1904 as the Kaiser Friedrich Museum by the Berlin architect Ernst Eberhard von Ihne. It was Wilhelm von Bode's idea that the museum houses the various collections of Christian-era sculpture. The building was badly damaged in the Second World War and only after successive phases of reconstruction, between 1948 and 1986, did it again become an exhibition venue shared by several collections at once. In 1956 it was renamed the Bode-Museum, after its spiritual founder. From 1999 to 2005 extensive restoration work was carried out for the building to meet the demands of a modern museum and to preserve its structure. Now, as originally intended, the museum again houses the Sculpture Collection and Museum of Byzantine Art, as well as the Numismatic Collection. In addition, numerous paintings from the Gemäldegalerie's collection are on view, enriching the exhibition of European sculpture.

Sculpture Collection and Museum of Byzantine Art

The Sculpture Collection is one of the largest collections of classic sculpture in the world. Its beginnings date back to the royal Brandenburgian Prussian Kunstkammer (or 'cabinet of art'), and to the time of the Great Elector (1640-1688) in particular. Through successive acquisitions, mostly of Italian sculpture, Gustav Friedrich Waagen and, most importantly, Wilhelm von Bode broadened the collection's scope. Their aim was to create a comprehensive display of the history of European sculpture. In the building, originally conceived as a Renaissance museum, the collection they created went on display in the then innovative form of a public museum. Together with historical architectural fixtures and select pieces of furniture, the artworks were placed in a setting that aimed to convey something of the time in which they were created. The rapid growth of the collection soon led to it being divided up in parts. The partitioning of Berlin after the Second World War also brought with it a break-up of the Sculpture Collection itself. After decades of separation, the collection has now been reassembled in the Bode-Museum once again.

The Museum of Byzantine Art owns an exquisite collection of artworks from late antiquity and Byzantine periods. The focus of the collection centers on the art of the Western Roman and Byzantine Empire in the period from the 3rd to 15th century and also contains a great number of post-Byzantine icons and craftwork objects. The artworks originate from nearly all areas that made up to the ancient Mediterranean region. There are four core aspects to the Berlin collections that lend them their unmistakable character: Roman sarcophagi and sarcophagus fragments from late antiquity provide a panorama of early Christian iconography, while the rich collection of figurative and ornamental sculpture from the Eastern Roman Empire gives visitors the chance to explore the region's stylistic diversity, on a scale rivaled only by the Archaeology Museum in Istanbul. Exquisite ivory carvings and mosaic icons attest to the high craftsmanship and artistic standards of art in the Byzantine court, while objects from everyday life and Christendom in Egypt give us a clue as to the life of ordinary people, as well as the equipment used in liturgical proceedings.

Numismatic Collection

With over half a million objects, many of which once formed part of the Kunstkammer of the Prussian kings, the Numismatic Collection now ranks as one of the most important coin collections in the world. Spread over four cabinets on the second floor, containing 4000 coins and medallions, the exhibition in the Bode-Museum presents a chronicle of human history in metal form, from the very beginnings of coinage in the 7th century BCE up to the euro coins of the 21st century. All exhibits are also on display and outlined in more detail online (www.smb.museum/ikmk). Further treasures in the Numismatic Collection currently not on view in exhibitions are available for study in the study room on the Bode-Museum's lower floor, where the numismatic special library can also be used.

Adress
Bodestraße 1-3, 10178 Berlin

Museum entrance
Am Kupfergraben 1
access via Monbijoubrücke

Opening hours
Tuesday – Sunday
10:00 am – 06:00 pm

Public transport
S/U-Bahn
S/U-Bhf. Friedrichstraße S1, S2, S25, U6
S-Bhf. Hackescher Markt S3, S5, S7, S75
Tram
Hackescher Markt M4, M5, M6
Am Kupfergraben M1, 12
Bus
Friedrichstraße 147
Lustgarten 100, 200
Staatsoper TXL

NEUES MUSEUM

Constructed between 1843 and 1855 and designed by Friedrich August Stüler, the Neues Museum (New Museum) constitutes a key work in the history of art, public museums and technology in the 19th century. After being closed for 70 years, it opened to the public again in October 2009. The Building suffered severe damage in the Second World War – exigency measures to safe-guard the structure were only undertaken in the 1980s. British architect David Chipperfield won an international architectural competition and was commissioned to reconstruct the museum building in 1997 Construction work began in 2003.

In the restoration work the facades and interior spaces were carefully preserved, with respect paid to the visible traces of the past on the structure itself. The result is that the building, a UNESCO World Heritage Site since 1999, has regained something of its original glory. The museum now unites under one roof exhibits that share geographical and historical affinities taken from three separate collections. The resulting combined exhibition traces the development of Old World cultures from prehistory and early history, from the Near East to the Atlantic, from North Africa to Scandinavia and is without parallel for its depth and richness.

Ägyptisches Museum und Papyrussammlung

The Ägyptisches Museum and Papyrussammlung (Egyptian Museum and Papyrus Collection) provide a comprehensive insight into the continuities and changes that occurred over the course of four millennia in ancient Egyptian and Nubian cultures. The exhibition starts with the history of the collection and of Egyptology itself. Moving from the display of the notion of king in various shapes of presentation, the exhibition leads to the magnificent Berlin Green Head, illustrating how sculpture progressed as a genre, before coming to the three offering chambers dating from the Old Kingdom that bring to life tomb architecture and relief art. The main floor (level 2) primarily features sculpture in the round. The typological display of private figures is followed by works from the Amarna period including the famous head of Tiy and the world-renowned bust of Nefertiti. The tour through Egypt ends in the 'Library of Antiquity', containing a selection of texts and literary works taken from the culture of writing that stretches all the way from Ancient Egypt down to late antiquity. Level 0 is dedicated to everyday life, the afterlife and the cult of the gods.

Museum für Vor- und Frühgeschichte with objects from the Antikensammlung

With 6000 exhibits on view, the Museum für Vor- und Frühgeschichte (Museum of Prehistory and Early History) provides a sweeping overview of prehistoric cultures in Europe and its neighbouring regions. On the ground floor (level 1), the room 'Odin, Urns and Looted Art' (room 102) greets visitors with historical wall paintings of Nordic mythological scenes. This is followed by the rooms dedicated to Heinrich Schliemann's collection of artefacts from Troy and the cultural history of neighbouring Cyprus. The route around the level 2 starts with the archaeology of the Roman provinces and depictions of Rome's

Germanic northern neighbours. Artefacts in the next room range from late antiquity to the start of Christian Western culture. Finally, the level 3 takes visitors back to the Stone Age with the Neanderthal from Le Moustier, the Bronze Age with the 'Berlin' Golden Hat and the diverse culture of pre-Roman Iron Age. The exhibition ends with the study collection presented in the style of the 19th century.

Adress
Bodestraße 1-3, 10178 Berlin

Opening hours
Monday – Sunday
10:00 am – 06:00 pm

Public transport
S/U-Bahn
S/U-Bhf. Friedrichstraße S1, S2, S25, U6
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Staatsoper TXL

NATIONAL MUSEUMS BERLIN

PERGAMON MUSEUM

The Pergamon Museum was built between 1910 and 1930 under supervision of Ludwig Hoffmann, based on designs by Alfred Messel, and was the last of the five museums to be constructed on the island museum complex in Berlin known as the Museum Island Berlin. The Pergamon Museum was designed with three separate wings, now housing the Collection of Classical Antiquities with the three halls of Greek and Roman architecture, the Museum of the Ancient Near East and the Museum of Islamic Art. The impressive reconstructions of archaeological ensembles have made the museum a place of world renown. As set out in the Museum Island Master Plan the Pergamon Museum is currently being restored and extended in certain sections under the direction of the Werkgemeinschaft Pergamon Museum.

Collection of Classical Antiquities

The Collection of Classical Antiquities dates back to the time of the Brandenburg electors and was founded in 1830 to house their collections of ancient sculptures and minor arts. Treasures excavated in archaeological sited in Greece and Asia Minor were gradually added to the collection, making it one of the most significant in the world. Today the Collection of Classical Antiquities is housed on three sites, with the Greek, Roman and Etruscan sculptures, vases, bronzes and gold jewelry on show in the Altes Museum, and the Greek and Roman architecture in the Pergamon Museum.

The main attraction in the Pergamon Museum is the Pergamon Altar (circa 170 BC). Its frieze is regaded as one of the masterpieces of Hellenistic sculpture and depicts the battle between the gods and the giants. The Market Gate of Miletus is a showpiece of Roman architecture dating back to the early 2nd century AD. In conjunction with the Museum of Prehistory and Early History, the Collection of Classical Antiquities also exhibits monuments from Cyprus and from the provinces of the Roman Empire in the Neues Museum.

Museum of the Ancient Near East

The Museum of the Ancient Near East has exhibits from Mesopotamia, Syria and Anatolia which bear witness to 6,000 years of cultural history. Founded in 1899, it boasts some 270,000 objects, most or them discovered during the major German archaeological excavations in Babylon, Assur, Uruk and Habuba Kabira. The main attractions include the huge architectural reconstructions of the Ishtar Gate with its colourful splendour and the Processional Way of Babylon dating back to the time of Nebuchadnezzar II (6th century BC), a fortified gate with stone sculptures and reliefs from the city of Sam'al / Zincirli (10th/ 9th century BC), and a coloured mosaic façade from Uruk (4th millennium BC), an example of the most ancient form of monumental religious architecture. No less important is the earliest evidence of human communication in cuneiform inscriptions on clay tablets from Uruk dating back to the end of the 4th millennium BC. The ancient objects from Assur in a 3rd millennium BC temple dedicated to the goddess Ishtar provide insight into the religious ideas people in Mesopotamia had. The exhibits illustrate the role of the

region as a seedbed of ancient and Occidental culture.

Museum of Islamic Art

The Museum exhibits arts and crafts from Islamic countries dating from the 8th to the 19th century. The Museum of Islamic Art was first set up in 1904, primarily housing the Mshatta Façade (Jordan, mid 8th century), a gift from the Ottoman Sultan to the German Emperor, and rugs from the Wilhelm von Bode Collection. The works of art on display today – from decorative architecture and crafts right through to book art – originate from a wide range of sources extending from Spain all the way to India. There is a concentration on the Near East including Egypt and Iran. Other highlights in the collection besides the Mshatta Façade include archaeological finds from Samarra, the seat of the Abbasid caliphate (Iraq, 9th century), the world-famous Aleppo Room (Syria, 1601), and miniatures from the Mughal court (India 16th – 19th century).

Adress
Bodestraße 1-3, 10178 Berlin

Museum entrance
Bodestraße 1-3

Opening hours
Monday – Sunday
10:00 am – 06:00 pm

Public transport
S/U-Bahn
S/U-Bhf. Friedrichstraße S1, S2, S25, U6
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Lustgarten 100, 200
Staatsoper TXL

NATIONAL MUSEUMS BERLIN

SHORT PRESENTATIONS

NATIONAL MUSEUMS BERLIN

ETHNOLOGICAL MUSEUM

Arnimallee 27, 14195 Berlin

With a total of 500,000 objects from throughout the world and large numbers of sound recordings, documentary photographs and films, the Ethnological Museum ranks among the largest and best of its kind. The museum collects, preserves and researches cultural products of pre-industrial societies, primarily outside of Europe.

The collection
The museum currently embraces the following collections: Africa, American archaeology, American ethnology, Europe, the Islamic World, Eastern and Northern Asia, South and South-East Asia, the South Seas and Australia, as well as the ethnology of music.

FRIEDRICHSWERDERSCHE KIRCHE

Werderscher Markt, 10117 Berlin

The Friedrichswerdersche Kirche (Friedrichswerder Church) was built between 1824 and 1830 after plans by Karl Friedrich Schinkel. As a brick building it follows the architectural tradition of the Marienkirche and the Nikolaikirche. Up to the present day, façade as well as interior match the original appearance. The twin-towered façade of the church, containing the main portal, points southwards to Werderscher Markt. Inside, one steps into a wide neo-Gothic space with a continuous wooden gallery. Here, Schinkel‘s life and his main Berlin works are explained in illustrated texts.

In the nave a selection of sculptures from Schinkel‘s time are on display. Among them are the original model of Johann Gottfried Schadow‘s most famous work, the „Two Princesses“, the marble tomb of the revered queen Luise von Preußen by Christian Daniel Rauch, several sculptures from the Berlin Palace, also effigies of Immanuel Kant, Johann Wolfgang von Goethe, the brothers Humboldt as well as numerous other sculptures - together they paint a rich and multi-faceted portrait of the Classicist era: its idea of man, its aims in the arts, and its achievements.

GEMÄLDEGALERIE

Matthäikirchplatz, 10785 Berlin

The National Museums‘ Gemäldegalerie has presented to the public masterpieces of older Western painting in its newly erected building at Kulturforum since 1998. The competition for the Gemäldegalerie‘s new building, held in 1986, went to architects Hilmer and Sattler. With Prussian exactness, the building‘s minimal design rises above the tapering piazetta below, while inside its various rooms are grouped around a bright, well-lit lobby. A study gallery was added to the Gemäldegalerie after the sweeping events of 1989 and 1990 that also led to the reunification of the various collections belonging to the National Museums in Berlin a year later in 1991.

In its architectural reserve, the building‘s minimal outer design is reminiscent of Schinkel‘s Altes Museum, while inside, the collection rooms bear similar classical proportions. From the large central lobby, itself a place of peace and contemplation with the water fountain and sculpture by Walter de Maria, visitors can delve back into the individual exhibition rooms and recontinue their tour through the collection. The consequential use of daylight illumination throughout sets a benchmark for other major art galleries. With its many famous masterpieces, the building now ranks once again as one of the major European galleries and offers a comprehensive overview of European painting from the 13th to the 18th century.

HAMBURGER BAHNHOF

Invalidenstraße 50-51, 10557 Berlin

The Hamburger Bahnhof was built in 1874 as one of Berlin‘s rail heads, but already in 1906 it was found too small for a station and was converted into a museum of traffic and building. Located in „no man‘s land“ between East and West Berlin, the Hamburger Bahnhof remained unused after the Second World War. Successive restoration began only after the GDR handed the building over to the City of Berlin in 1984.

In 1987, the Hamburger Bahnhof was assigned to the Stiftung Preußischer Kulturbesitz (Foundation of Prussian Cultural Heritage). The 1989 competition for the conversion of the building was won by the architect Josef Paul Kleihues, a museum specialist who designed an ideal concept for the multi-functional usage of the new museum.

The large entrance hall serves as a central space for orientation and leads to all other parts of the building. From there, one can reach the two-storey western wing of the cour d‘honneur, the ground floor of which serves as a permanent exhibition space dedicated to the work of Joseph Beuys. The eastern wing contains a restaurant and events forum. The great hall and the modern galleries are used for special exhibitions.

Since September 2004, the Friedrich Christian Flick Collection with its first-class masterpieces is on permanent loan to the Staatliche Museen zu Berlin (National Museums in Berlin) and shown in the neighbouring Rieck halls.

KUNSTBIBLIOTHEK

Matthäikirchplatz, 10785 Berlin

The Kunstbibliothek (Art Library) has approximately 400,000 volumes and ranks among Germany‘s leading institutions specializing in literature concerning the history of art. The library attracts 35,000 visitors annually.

The Art Library acquires and researches scientific literature on the history of European art from late antiquity to the present. It also subscribes to 1,400 current international periodicals. In addition, it collects drawings and prints in the area of applied arts and possesses a comprehensive collection of photographs.

The library offers visitors a broad range of impressive collections including: architectural and ornamental prints and drawings, the Lipperheide costume library, posters and advertisements, graphic design, book design, photographs. All items are available to visitors in the reading rooms.

Selections of works from the library‘s many collections are regularly presented in special exhibitions. The neighbouring Kupferstichkabinett (Museum of Prints and Drawings) concentrates primarily on fine art drawings and prints.

KUPFERSTICHKABINETT

Matthäikirchplatz 8, 10785 Berlin

The Kupferstichkabinett houses the collection of graphic arts within the network of the Staatliche Museen zu Berlin (National Museums in Berlin). It is a centre of research, for collecting and exhibiting drawings, prints and illuminated manuscripts.

It houses the largest collection of graphic art in Germany and ranks among the four most important institutions of its kind anywhere in the world. The collection encompasses European drawings and prints from the Middle Ages to the present as well as related international works. Illuminated manuscripts from the Middle Ages and the Renaissance can be found alongside illustrated books, portfolios, sketchbooks, topographical views and maps and printing plates. This “universe of art on paper” includes works spanning a period of 1,000 years of art, culture and media history. The museum houses around 550,000 prints and 110,000 drawings, watercolours, pastels and oil sketches. With its treasures the institution is therefore a central location for artistic ideas; for pictures and European forms of expression, and for other world cultures connected to Europe. The Kupferstichkabinett is traditionally a location for research and connoisseurship. Due to the extensiveness of its collection and the sensitivity of works of art on paper there is no permanent display. Instead, there are special exhibitions and regular temporary and studio displays in the Kupferstichkabinett as well as in affiliated museum galleries. This engagement is being complemented with additional offers of study, aesthetic education, as well as information and stimulating conversation.

MUSEUM BERGGRUEN

Schloßstraße 1, 14059 Berlin

With its permanent exhibition, ‘Picasso and His Time’, the Museum Berggruen has been one of the jewels in the German capital’s crown since 1996. More than 100 works by Pablo Picasso form the heart of the collection, including paintings, drawings, prints and sculptures, spanning all creative periods of this giant of 20th-century art, from the early years of his Blue and Rose Periods up to his erotically charged late work. Over 60 outstanding works by Paul Klee and more than 20 works by Henri Matisse complement the collection, as do works by Alberto Giacometti and sculptures of African origin. With great passion and incredible intuition, Heinz Berggruen (1914–2007), art dealer, collector,

author and patron of the arts, compiled this exquisite collection over a period of more than 60 years. Starting out as a journalist, Berlin-born Berggruen began his career in 1947 as an art dealer in Paris and met most of the artists he represented in person. Initially intended as a ten-year loan, the bulk of the Berggruen collection was handed over to the Nationalgalerie at a generously low price in December 2000. Loans from the Berggruen family's private collection enrich the permanent exhibition.

MUSEUM OF ASIAN ART

Arnimallee 27, 14195 Berlin

The Museum of East Asian Art and the Museum of Indian Art were merged in December 2006 and now operate under a new joint name, the Museum of Asian Art.

The Collection of South, Southeast and Central Asian Art houses one of the most important collections worldwide of art from the Indo-Asian cultural area, from the 4th millenium BC to the present. This extensive geographic region includes, next to India, the regions Pakistan, Afghanistan, Sri Lanka, Bangladesh, Nepal, the Autonomous Regions Tibet and Xinjiang of the People's Republic of China, the Southeast Asian countries of Myanmar, Thailand, Cambodia, Vietnam, as well as the Indonesian Islands.

The Collection of East Asian Art presents a comprehensive exhibition embracing the broad spectrum of art from China, Japan and Korea. Highlights include the collection of Japanese paintings and East Asian lacquer art works from the collection of Klaus Friedrich Naumann, as well as the Berlin collection Yuegutang featuring Chinese ceramics from the Neolithic period up to the 15th century.

The unification of these two collections will make the most efficient use of the resources available. The merger has been carried out with the plans of the Stiftung Preußischer Kulturbesitz in mind to create the Humboldt-Forum: a forum on Schlossplatz in Berlin-Mitte where the extra-European collections will be presented following an innovative concept. Together with the holdings of the Ethnological Museum and the collections of Western art and culture located on Berlin's Museum Island, a vision of an educational landscape of world ranking will come into existence.

MUSEUM OF DECORATIVE ARTS

Matthäikirchplatz, 10785 Berlin

The Kunstgewerbemuseum (Museum of Decorative Arts) is one of the oldest of its kind in Germany. It possesses one of the most important collections of skilled craftsmanship. The museum can be found at two sites: Kulturforum and Schloss Köpenick (Köpenick Palace).

NATIONAL MUSEUMS BERLIN

MUSEUM OF EUROPEAN CULTURES

Arnimallee 25, 14195 Berlin

The Museum of European Cultures was called into being in 1999 and was created by merging the 110 year-old Museum of European Ethnology (Museum für Volkskunde) with the European collection of the Ethnological Museum. It focuses on lifeworlds in Europe and European cultural points of contact from the 18th century until today. Comprising some 275,000 original objects, the museum houses one of the largest European collections of everyday culture and popular art. The topics covered by the collection are as diverse as the cultures of Europe themselves: ranging from weddings to commemorating the dead, the cult of Napoleon to Halloween, music on Sardinia, the historically pagan ‚Perchten' processions in the Alps ... the list goes on and on.

After two years of extensive renovation work, the Museum of European Cultures is reopened to the public since 9 December 2011, in the modernist building designed by Bruno Paul in Dahlem. The permanent collection, ‚Cultural Contacts. Living in Europe' is on show alongside the rotating presentation of the study collection, beginning with ‚Children's toys from Europe'.

MUSEUM OF PHOTOGRAPHY

Jebensstraße 2, 10623 Berlin

Part of the National Museums in Berlin, the Museum of Photography is the exhibition location for the history of photography from its beginnings to the present. The museum comprises two institutions: The Art Library with its Collection of Photography in the Kaisersaal and the Helmut Newton Foundation on the first floor and on the gound floor.

Originally, the building dating from 1909 was the officers' mess of the Prussian Territorial Army including a foyer, rooms for festivities and an impressive ballroom, the so-called Emperor's Hall. After an eventful history, the building served as home for the Art Library from 1954 to 1993.

In 1994, the Art Library moved to the Kulturforum Potsdamer Platz and thus opened up soace for photography. Ten years later, the Helmut Newton Foundation moved to occupy the lower two floors. On occasion of the building's 100th anniversary in 2009 followed the opening of the Kaisersaal as an exhibition platform for the Collection of Photography of the Art Library.

NEW NATIONAL GALLERY

Potsdamer Straße 50, 10785 Berlin

The Neue Nationalgalerie was opened in 1968 and is the last work completed by the world-renowned architect Ludwig Mies van der Rohe. The architect's long-term preoccupation with creating fluid, open space culminated in the design of the glazed upper pavilion of

the gallery. Mies van der Rohe died just shortly after the building opened: thus the Neue Nationalgalerie with its steel roof and minimalist form is not only an icon of modern architecture but also stands as a testament to one of the most visionary architects of the 20th century. At the time of construction, the museum was situated close to the border of West Berlin and was an essential component of architect Hans Scharoun‘s plans to establish a ‚Kulturforum‘-a centre for art and culture-in this area. After German reunification and the reconstruction of Potsdamer Platz, the Neue Nationalgalerie now finds itself in a vibrant district in the centre of the city.

The Neue Nationalgalerie hosts rotating exhibitions focussing on 20th-century art. The gallery‘s large collection includes important works by numerous artists from Europe and North America, such as Ferdinand Hodler, Edvard Munch, Pablo Picasso, Ernst Ludwig Kirchner, Max Beckmann, Otto Dix, Paul Klee, Max Ernst, Salvador Dalí, Francis Bacon, Ernst Wilhelm Nay, Werner Tübke, Gerhard Richter and Andy Warhol. Among the best-known works are ‚Potsdamer Platz‘ by Ernst Ludwig Kirchner, ‚The Skat Players‘ by Otto Dix and ‚Who‘s afraid of Red, Yellow and Blue IV‘ by Barnett Newman.

The current exhibition is dedicated to art from the post-war era, showcasing works from between 1945 and 1968. The gallery‘s collection of modern art was on exhibit up to the end of 2012 and is currently no longer on display.

SAMMLUNG SCHARF-GERSTENBERG

Schloßstraße 70, 14059 Berlin

With its ‘Surreal Worlds’ exhibition, the Sammlung Scharf-Gerstenberg presents a magnificent collection of surreal and Surrealist works of art, ranging from the precursors of the Surrealist movement up to its main representatives in Paris in the 1920s and 30s. Works by Giovanni Battista Piranesi, Francisco de Goya, Gustave Moreau and Odilon Redon, who were already creating surreal compositions in the 18th and 19th century, are shown alongside paintings, sculptures and collages by famous Surrealists, including Max Ernst, René Magritte, Salvador Dalí, André Masson and Yves Tanguy. The museum also features comprehensive individual exhibitions dedicated to the work of Hans Bellmer, Paul Klee, WOLS and Jean Dubuffet. Surrealist films by Dalí, Luis Buñuel and contemporary artists working in a Surrealist vein, such as Rosemarie Trockel, complement the collection.

The beginnings of the Sammlung Scharf-Gerstenberg date back to Berlin around 1910 and the enthusiastic art lover Otto Gerstenberg (1848– 1935). He compiled a very impressive private collection that ranged from the old masters to Impressionism. His grandson, Dieter Scharf (1926–2001), inherited parts of what remained of the collection, as well as his grandfather’s passion for collecting. With great connoisseurship, he expanded his own collection, focussing on the fantastical and surreal from the 1950s onward. His collection is now on public view in Charlottenburg as a long-term loan for an initial ten-year period.

RESEARCH ALLIANCE CULTURAL HERITAGE

The formal agreement by the Fraunhofer-Gesellschaft, the Leibniz-Gemeinschaft and the Stiftung Preußischer Kulturbesitz to found the »Research Alliance Cultural Heritage« was signed in the Altes Museum in Berlin in October 2008 by Prof. Ulrich Buller, Prof. Ernst Theodor Rietschel and Prof. Hermann Parzinger. The highest priority of this interdisciplinary cooperation is the preservation of our cultural heritage using the results of research and innovation in materials science. Documents, paintings, sculpture and historic buildings are essential elements of our cultural identity. Such treasures are not only a manifestation of the achievements of our civilisation, but also have considerable economic value, for example, for tourism. Cultural heritage is, however, ephemeral and cannot be regarded as a renewable commodity. Preserving it requires a sustainable approach as well as a commitment made by society as a whole. Environmentally induced damage to works of art and other cultural objects is extremely complex, so that their protection and preservation require an interdisciplinary approach. Specific research projects as well as the development of innovative and sustainable technologies are the most important elements in preserving our cultural heritage. The Research Alliance coordinates the activities of its member organisations in this area and promotes knowledge transfer between research and practice. The Research Alliance and further associated partners campaigns in a concerted way for the permanent preservation of works of art and other cultural objects. Areas of excellence are set up and synergies utilised.

Areas of activity (some examples)

- preservation and preventive conservation
- modern procedures for documenting historic monuments and archeological sites
- non-destructive testing procedures and their validation
- new cleaning and decontamination technologies
- adaption of innovative technologies to the preservation of cultural heritage (i.e. plasma technology for cleaning and applying protective coatings)
- development of new, sustainable materials for conservation (in particular for 20th century cultural objects)
- energy efficient climate concepts for museums, art collections and archives
- implementation of the concept of sustainability in the field of cultural heritage

Mission and Aims

- identifying unsolved preservation problems and defining research aims and priorities in cultural heritage protection
- carrying out joint research projects for the development of new techniques in restoration and conser- vation
- introducing standardized, feasible and economic test and analysis procedures
- supporting young academics
- offering opportunities in training and further education
- expanding national and international networks in the field of cultural heritage protection
- initiating and drafting (national) contract funding programmes in the area of restoration and conservation research
- recording the impact of climate change on the preservation of cultural heritage
- creating an open platform of exchange between research, society and business
- demonstrating the importance of preserving our cultural heritage at the political level and to society in general

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