Indoor Cli m ate and Tourisme Effects

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1. Introduction

The Bavarian department for state castles, palaces, Gardens and Lakes owns 51 objects which are opened to the public. Some objects can be visited only by guided tours, others are to be visited like museums. The number of visitors for all monuments reached 5 941 718 persons in the year 2000. The Visitors frequency centred from may to September with more than 4 Mill. of visitors.

2. Climate as a damaging factor

All monuments contain climate sensitive materials or they are just constructed out of them. Some materials and some sceneries which are regarded as main damaging factors on wall paintings and stones are listed below, it was not intended to set up a complete list of damaging factors.

- **Salts** cause damages because of pressure which occurs during crystallisation/hydration in porous building materials
- **material dilatation**

  Expansion and shrinkage caused by changes of relative humidity or light exposure leads to damages on decorations f.e. cracked gildening
- **Biological attack**

  High relative humidity, very often in combination with water penetrated architecture, is one of the main factors for the growth of damaging biological and microbiological organisms.

3. Examples

3.1 Castle Linderhof:

Linderhof goes back to a hunting lodge which was erected by the Bavarian King Ludwig I. The house served as a home for hunting parties in the Bavarian alps. It was the idea of King Ludwig II to transform this hunting lodge into a representative castle in the neobaroque style. The idea was realized from 1874-1878. The castle is open to the public all over the year and can be visited by guided tours. More than 630 000 visitors were counted in the year 2000.

The castle shows the decorations of the neobaroque style with gilded stuccos, the interior decorations and the furniture is original and goes back to Ludwig II.

The climatic situation of the building was regarded as a very problematic one, because of the huge number of visitors during a year and the limited extensions of the castle, which is situated in an extreme meteorological situation in a valley of the Bavarian alps. Occuring damages on the decoration were therefore regarded as a result of climatical stresses, going back to the tourist using. Climatic measurements undertaken in the year 1994 lead to the following results:

The temperature of the air ranges from 3°C to 25 °C, the relative humidity spreads from 50 – 80%. The strong differences of the outside climate are not repeated inside the castle , changes of Temperature and relative humidity are buffered to a moderate extent. It seems that the hygroscopic capacities of the lime plastered walls absorbes humidity to a certain extent and desorbes in the months with less visitors. The measurements demonstrate, that the materials properties produces more or less stable climate conditions without abrupt changes in humidity between day and night. The development of the damages on the decorations were not supervised during the climate measurements, because of lacking appropriate monitoring methods. This means, that the results of the undertaken climatic measurements are not useful to explain damaging mechanisms to the neobaroque decorations.

3.2 Bayreuth Operahouse

The opera of Bayreuth was erected from 1744-1748 under Wilhelmine the daughter of the Prussian king Friedrich Wilhelm I. The baroque theatre of Bayreuth is regarded as one of the most impressing theatres in Europe and dates out of the 18$^{'th}$ century and is in a very well preserved condition, because it wasn't used for a long time. The galleries and balustrades are painted and gilded. The ceiling is covered by a painting on textile. The theatre was restored between 1963 and 1980 and is, despite its fragile condition, still in use as a opera – house. In order to prevent harm to the theatre, as much as possible, its use is restricted to three playing blocks within a year. The opera-house is open to the public and can be visited by guided tours. The climate is controlled by an airconditioning system which can be run in three working modes.

- museum-mode

  The air-condition works when the Temperature falls under 7°C or the rel. humidity exceeds 55 % ,+/- 10%

- heating-mode

  Preparation of a comfortable climate for the playing blocks with a limited heating rate of 1 K per day.

- theater-mode

  relative humidity 55%

  roomtemperature 20°C

climatic measurements:

Measurements were taken during four campaigns, all of them proved that the fixed climate limits, especially during the theatre mode, were regularly passed over.

As the theatre is very popular to the citizens of Bayreuth, exists a remarkable demand for numerous cultural events. This is the reason that the town of Bayreuth, with its mayor, wants to exceed the limited playing blocks from three to four. In order to get a theatre which can be used all over the year, the installation of a fully dimensioned air-conditioning system is proposed. To realize such points of view, a strong political pressure has been carried out.

4. Conclusion:

Cultural Heritage Objects are examples of rare complexity, Objects like that very often own a very complicated architecture and building history, they are constructed or decorated in combination with numerous materials, reacting different on climatically changes. Measurements of the climate are standard, the equipment is available in good qualities. Investigations about the physical properties of materials in relation to climate-exposure is known for several groups of materials.

Data for the thermodynamics of material combinations are very rare. But they are the missing link, if climate researches shall lead to scientifically based predictions of the behaviour of art-objects. Research-projects will lead to another quality when we are able to link data describing the materials reactions under authentic climate conditions. Monitoring methods are already known, but they should be developed to useful tools. Several methods, very simple ones and others requiring high tech equipments, for the monitoring of surfaces were described during the BMBF-Project which was financed by the german State from 1988 to 1997.

- Photographic/video based methods for the micromonitoring on mural paintings
- monitoring methods for the description of material losses
- Mapping methods for the description of surface-alterations
- Laserinterferometrie: a sort of laser scanning, which can be focussed to a precision of nanometers, in order to describe movements of the surface.

Intensive attempts in the investigation of objects are necessary to get a better standard in detailed research which might help us to a better and detailed planning of conservation interventions.

But we also have to convince our contemporaries, and especially our politicians, about the fact, that the extensive use of monuments for the modern event-culture, will harm and by long destroy our monuments and art objects.