A METHODOLOGICAL APPROACH TO THE SAFEGUARD OF THE WOODEN DOOR OF TODI CATHEDRAL

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1. Introduction

The study for the central wooden door of the Todi Cathedral has been the subject of two theses of the Faculty of Conservation of Cultural Heritage of Tuscia University (Genco [1], Maura [2]). The aim of the research was to characterize the state of conservation of the artefact in comparison with the environmental microclimate. In parallel with the microclimatic survey, naked eye observations, laboratory analyses of the wooden species (carried out in the Department of Forests and Environments Laboratory of Tuscia University) and of the restoration materials (carried out in the Laboratory of Diagnostics for Conservation and Restoration "Michele Cordaro" of the Faculty of Conservation of Cultural Heritage of Tuscia University) have been also performed, in order to obtain experimental data valuable for conservation (Genco [3]). A bibliographic study of documents available at the archive of Todi Cathedral has allowed to reconstruct the historical phases of realization and past restorations of the artefact.

The wooden door of Todi Cathedral was realized in 1521 by the master Antonio Bencivegna da Mercatello da Massa (fig. 1a). In 1623 it was seriously damaged by a lightning, so some years later, in 1639, the door was partly reconstructed by the artist Carlo Lorenti. Instead the plinth was reconstructed in 1792 (fig. 1b).

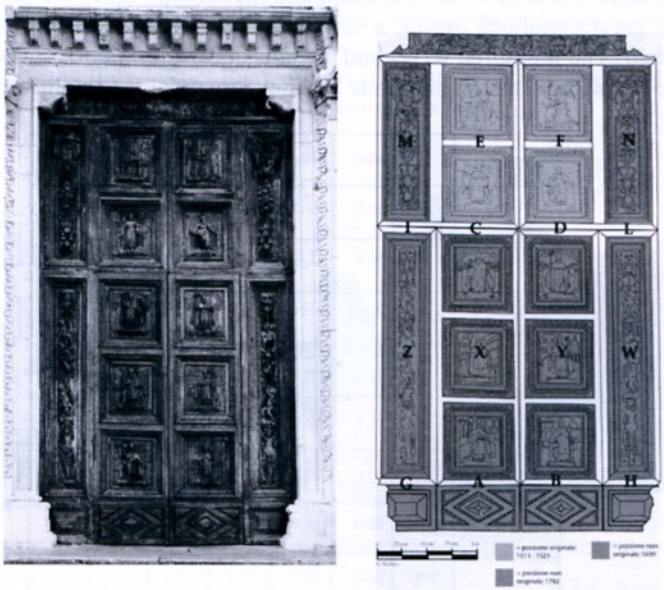

Figure 1 Outside surface of the door and mapping of the historical manufactured phases.

Afterwards the door underwent several restoration interventions; the last one was carried out between 1998 and 1999. Nowadays the state of conservation of the door is seriously compromised because of both the last incorrect restoration interventions and the position that the wooden door takes up in the Cathedral façade. The deterioration of the surface above all was caused by the variations of temperature and relative humidity (RH%) and it is different in the various parts of the door. In fact, the inner surface shows a less deterioration due to both the more stable environmental conditions and the plain manufacturing typology.

2. Material and Methods

Two punctual microclimatic surveys were carried out, in winter and in summer, including measurements, in correspondence of door's specific areas, of: air relative humidity, superficial temperature and moisture content of the wood, and finally solar radiation. These surveys were realized during five days, in winter and in summer, between 8.30 am and 4.30 pm, at intervals of an hour. The solar radiation was monitored only during the summer survey. The punctual measurements were carried out on thirty two points, grouped by eight and marked with capital letters. In addition, two dataloggers were placed indoors, specifically near the interior surface of the door and on the wooden chorus of the Cathedral and a third outdoors, in the bell-tower, in order to monitor relative humidity (RH%) and air temperature (T) for about a month, in winter and summer. The restoration materials and the different wooden parts were examined. The chemical analyses were carried out by means of FTIR and micro-FTIR spectrophotometry. The characterization of the wooden species was obtained by means of macroscopic examination and of observation of the thin sections of the wooden samples under an optical microscope.

3. Results and Discussion

The RH% and T average values both in winter and summer are typical of these seasons; considerable differences between minimum and maximum values are put in evidence (table 1).Moreover great variations during a single day and between differents days of a month were registered. The measured RH% and T values near the interior surface of the door and in the bell-tower showed the same trends but they are undoubetdly different.

		Max	Min	Daily average	Nightly average	Monthly average	Monthly standard deviation
Winter measurements DOOR	RH%	98,6	32,2	72,7	72,3	72,5	14,8
	T°C	16,8	3,5	8,6	8,1	8,3	1,2
Winter measurements BELLTOWER	RH%	99,9	33	81,9	83,7	82,9	11,4
	T°C	15,6	-1	6,4	5,9	6,1	2,1
Summer measurements DOOR	RH%	76,1	14,9	42,3	43	42,7	7,5
	T°C	34,8	20,7	28,5	27,6	28	1,4
Summer measurements BELLTOWER	RH%	96,9	20,9	52,7	54,7	53,9	10,7
	T°C	32,5	16,1	25,7	24,8	25,2	2,2

Table 1 Winter and summer measurements of temperature and relative humidity. Average values and standard deviations are reported.

The microclimatic parameters are in fact much more variable near the door because of the close contact with outdoors. The analysis of the punctual measurements gave an important contribution to the knowledge of the microclimatic conditions of the door that affect its physical and mechanical properties. The winter temperature graph shows an heterogeneous distribution of the values (fig. 2). The lower T values were registered on the C and D points corresponding to the shutters that can be opened and that are less subject to the solar radiation. The winter inner surface situation of the door is more stable due to the smaller RH% and T variations. During the summer the outside average temperatures range from 30,3 to 45,6 °C: these high values are worrying for the preservation of the door (fig. 3). On the contrary, the inner situation is more stable with temperature values ranging from 25,6 to 27,5 °C.

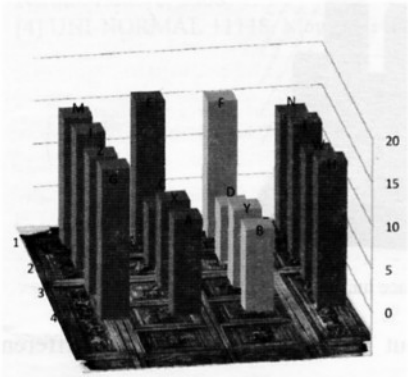

Figure 2 Average winter outdoor temperatures (°C)

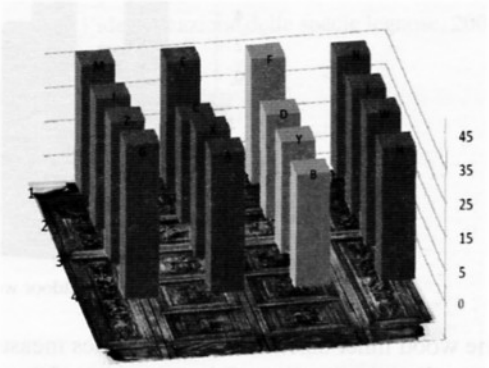

Figure 3 Average summer outdoor temperatures (°C)

The winter outside and inside air RH% values show an homogeneous trend. C and D points have different RH% values compared with the other ones, in particular 62,5% and 62,8% respectively (fig. 4). During the summer there are great variations of the RH% values due to the influence of solar radiation that affect the door facing to south (fig. 5).

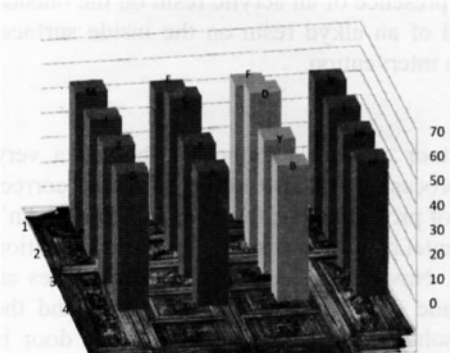

Figure 4 Average winter outdoor RH% values

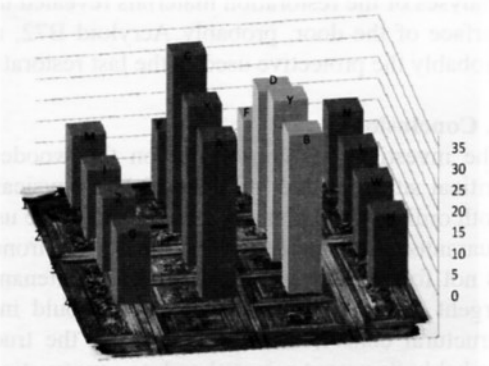

Figure 5 Average summer outdoor RH% values

These considerable fluctuations give rise to unremitting movements of the wood because of the absorption and desorption of water vapour. The RH% values show great variations also between the different areas of the door: they range from 16,3% to 18,1% as regards the fixed panels, whereas they range from 32,3% to 41,9% as regards the shutters that can be

opened. This lack of air hygrometric equilibrium near the outside surface of the door may be considered the main cause of deterioration of the wooden matter.
The wood outside surface humidity values keep under 12% (this is considered an optimum value for the preservation of wooden works of art) and they lower to 6% during the summer (fig. 6).

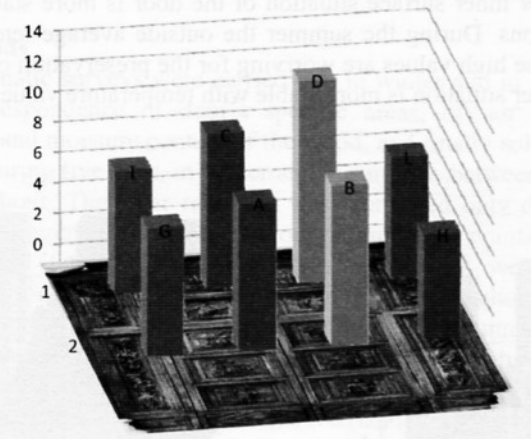

Figure 5 Average winter outdoor wood surface humidity values (%).

The wood inner surface humidity values measure about 18% underlining again the different microclimatic situation of the two sides of the door.
The total solar radiation values are clearly too high (about 600 W/m^2) compared with the museum standard suggested for the preservation of the wooden works of art (10 W/m^2).
The macroscopic examination of the door and the observation of the thin sections of the micro samples taken from the inside and outside surfaces allowed the characterization of the wooden species. The outside areas of the door are manufactured with walnut (*Juglans regia* L.) whereas the inside ones are obtained with poplar (*Populus* sp.). The DRIFT FTIR analyses of the restoration materials revealed the presence of an acrylic resin on the outside surface of the door, probably Acryloid B72, and of an alkyd resin on the inside surface, probably the protective used in the last restoration intervention.

4. Conclusions

The investigations carried out on the wooder door of Todi's Cathedral showed a very critical situation due to chemical and physical processes but also to the lack of a correct both ordinary and planned maintenance. The use of protectives on the door surfaces doesn't guarantee a long preservation from the environmental conditions expecially if this operation is not followed by a valid planned maintenance. Nowadays the door of Todi requires an urgent restoration intervention that should include the cleaning of the surfaces and the structural consolidation. Nevertheless the true solution for the safeguard of the door is probably its urgent removal and its conservation inside the church, in controlled conditions.

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References

[1] G. Genco, *La porta lignea del Duomo di Todi: aspetti conservativi*, Tesi di laurea inedita discussa presso la Facoltà di Conservazione dei Beni Culturali di Viterbo, relatore prof.ssa C. Pelosi, a.a. 2005/2006.

[2] C. Maura, *La porta lignea del Duomo di Todi: analisi del microclim*a, Tesi di laurea inedita discussa presso la Facoltà di Conservazione dei Beni Culturali di Viterbo, relatore prof.ssa C. Pelosi, a.a. 2005/2006.

[3] G. Genco, A. Lo Monaco, M. Marabelli, C. Maura, C. Pelosi, *La porta lignea del Duomo di Todi. Indagini climatiche e conoscitive finalizzate a una proposta conservativa*, Kermes, anno XXI, 69, Nardini Editore, 2008, 49-59.

[4] UNI-NORMAL 11118, Manufatti lignei. Criteri per l'identificazione delle specie legnose, 2004.