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## Environmental monitoring and building simulation application to Vasari Corridor: preliminary results

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### Abstract

The Vasari Corridor has been used in the past and present for storage and presentation of works of art which require control of microclimate for optimal preservation. To this end, it was started the collaboration between the Uffizi Gallery and Laboratory of Environmental Physic of the Florence University for the environmental monitoring of microclimatic parameters, of which this work presents the preliminary results.

It's also created a three-dimensional model of the building in the stretch from the Uffizi Gallery to Ponte Vecchio, for the dynamic simulation of the energy behavior of the building validated by on-field measured values.

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## 1. Introduction

In Museums, the preventive conservation is fundamental for the preservation of the artifacts exposed and to reduce the process of exhibits degradation and restoration [1,2].

Preventive conservation is a combination of actions directed to reduce the risk of degradation of the exposed object and to identify optimal environmental conditions to show the object in the safest way [3]. It implies both passive techniques, aimed to minimize the potential damage to the object from the exhibition environment, and environmental monitoring and management directed to minimize fluctuations of indoor environmental parameters and to reduce impacts from outdoor (windows openings, visitors crowding, irregular HVAC operation, wrong positioning of HVAC terminals and lighting elements, etc.). In particular the stability of temperature and relative humidity plays a key role in the deterioration processes of the cultural heritage [4,5]. Microclimatic monitoring of museums rooms, as well as lighting level measurement and sampling of indoor air pollutants, is necessary to assess the museum environment suitability to conserve exhibits and to plan any actions required to reduce degradation risk [6,7].

Italian technical regulations about cultural heritage conservation [8,9] establish guidelines and methods to measure indoor temperature, humidity and lighting level. It is important to underline that, pursuing the goal of cultural heritage conservation, it is impossible to fix for each object absolute values or ranges of optimal values of the environmental parameters. An optimal compromise between various issues concerning museums must be looked for. Especially in historical buildings turned into museums is very often necessary to carry out a compromise between objects conservation, public fruition and both visitors and occupants comfort [10].

To study and analyze thermo-hygrometric parameters values that can affect the exhibits conservation, in July 2016 an environmental monitoring campaign has been started in the Vasari Corridor of Florence. The monitoring system consists of several data loggers located in different parts of the museum.

Aim of this study is to analyze the monitoring results and to create a three-dimensional model of the building, to run a dynamic simulation of the energy behavior validated by the measured values. This will allow to analyze the responses of the building to weather solicitations, the behavior of the building with a possible HVAC system also for reducing management costs, and the effectiveness of passive strategies for the energy refurbishment, such as thermal insulation of the roof, replacing windows and natural ventilation, etc. Finally, the results constitute the knowledge base essential if we want to change the setting of the corridor or consider other destinations.

### Nomenclature

$g$	Solar factor, (-)
PI	Performance Index, %
RH	Relative humidity, %
$U$	Thermal transmittance, $W/(m^2K)$
$U_g$	Thermal transmittance of the glass, $W/(m^2K)$
$U_w$	Thermal transmittance of the window, $W/(m^2K)$
$\theta$	Dry bulb temperature, °C
$\theta_s$	Surface Temperature, °C
$\Delta\theta_{24}$	Daily gradient of temperature, °C
$\Delta RH_{24}$	Daily gradient of relative humidity, %
$\tau_v$	Light transmittance, (-)

## 2. Description of the Vasari Corridor in Florence

The elevated passage known as the Vasari Corridor is an enclosed and privileged connection built to join Palazzo Vecchio with Pitti Palace. It was commissioned by Cosimo I de' Medici on the occasion of the wedding between his eldest son, Prince Regent Francesco, and Archduchess Joanna of Austria, sister of Emperor Maximilian II,

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