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MSc Dissertation 2015

Conversion of “Santo Domingo of Atares” castle

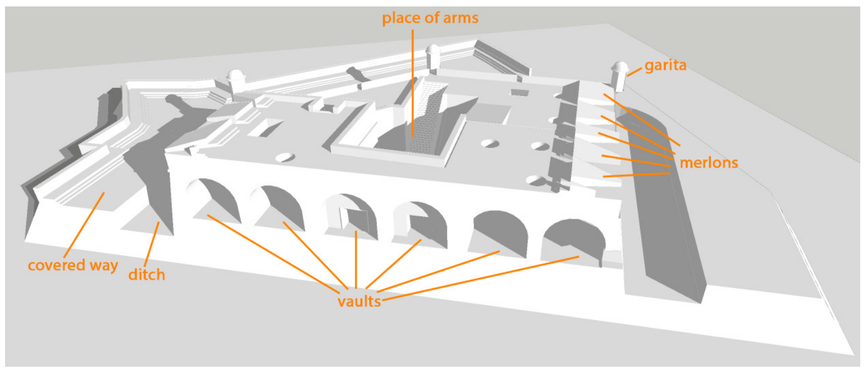
Sustainable conversion and retrofit of heritage buildings in Havana’s historic centre (23.1ºN, 82.3ºW)

In the Caribbean, South America and even North America fortifications are a recurrent topic in the field of conservation of historic buildings. In this typology every architectonical element has historic value, therefore, very few interventions are allowed, making the conversion of fortifications a very challenging task. In the last two decades in Cuba, there have been examples of refurbishments and conversions of fortifications into museums, some of them with dire consequences for the collections and the structures. Moreover the accommodation of modern functions and the preservation of the structure heavily rely upon the balance between various environmental parameters of the interior spaces.

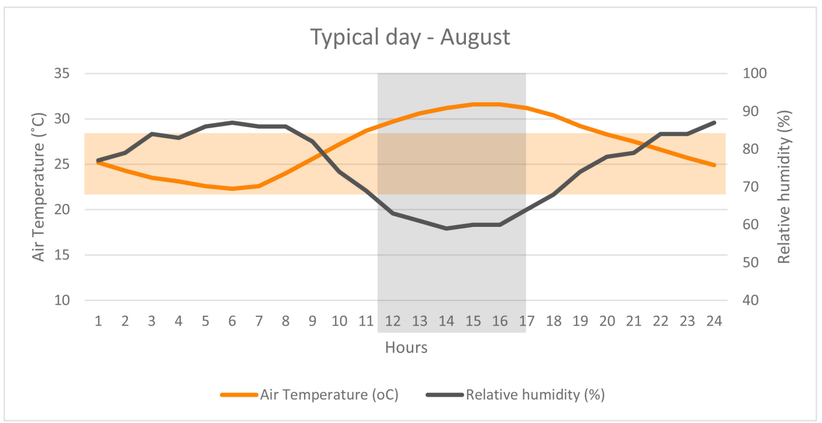
This study explores the challenges and opportunities of an environmentally driven conservation approach to the refurbishment of one of Habana’s most iconic XVIII century’s defensive structures, Santo Domingo of Atares’ Castle. The dissertation illustrates the development of an architectural proposal for the conversion of the castle into a museum and associated energy and environmental strategies. The museum function is particularly demanding due to the rigorous standards for the preservation of the collections, conventionally accomplished by mechanical equipment. Recently, however, there has been a major concern in the conservation scene about energy consumption and sustainable practices in historic buildings, with examples worldwide. Therefore, the work aims at identifying the characteristics of the existing climatic and environmental conditions affecting the interior spaces of the thermally heavyweight fortress, in order to device passive and hybrid strategies for the new function. This led to an analysis of the requirements of the collection in a hot-humid climate in conjunction with the parameters for human comfort, in order to identify to what extent the original conditions can be passively modified to adapt the building to the conversion. Finally, with the help of computational dynamic simulations, passive strategies and zoning options were tested for the achievement of suitable interior environmental conditions and energy savings.

Image of one of the vaults with Da Vinci’s artefacts exhibition

Context



Structure of Atares castle. Every element found today has historic and architectonical values, therefore its conservation is fundamental.



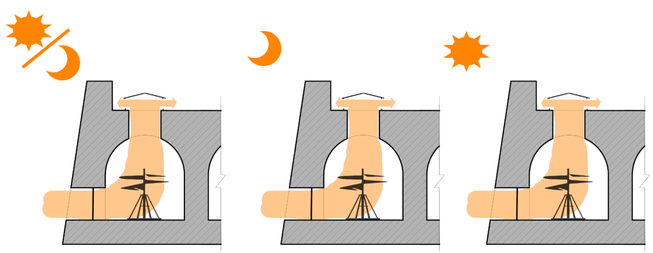
Air temperature and Relative Humidity values for a typical day in August in Havana, Cuba. The behaviour of both values is opposite during the day. Relative humidity very high at night and temperatures reach its peak the mid-day. The acceptable values occur at different times for each parameter.

Da Vinci’s artefacts are wood, leather and fabric objects of different sizes and types of interaxtion and exhibition modes. For its preservation in hot-humid climates it is needed conditions of less than 70% of relative humidity.

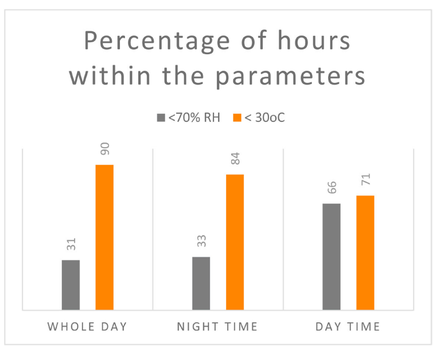
Design studies

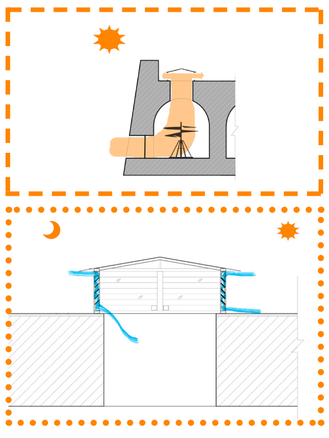
THERMAL ANALYSIS

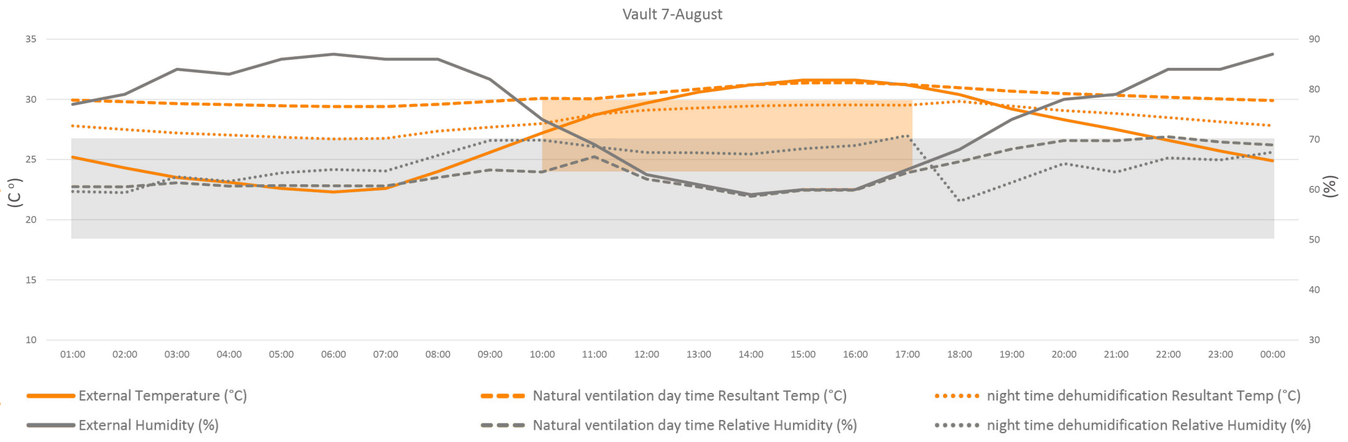
The parameters tested with thermal dynamic simulations inside the castle were temperature below 30oC (10am-5pm) and relative humidity below 70% for 24 hours. Natural ventilation strategies were tested



Whole day ventilation *Night-time ventilation* *Day-time ventilation*

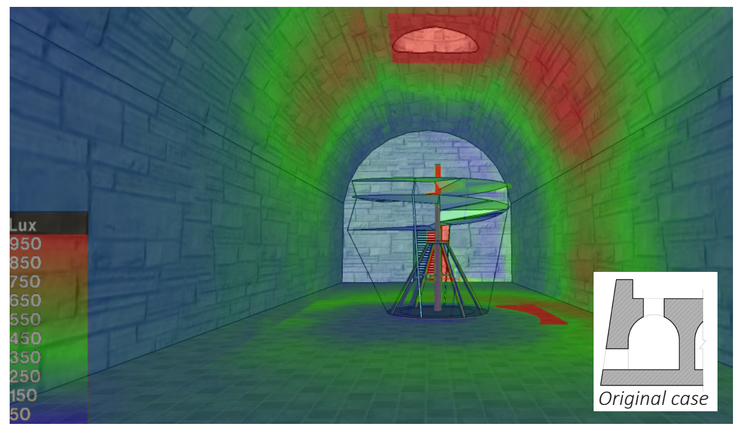


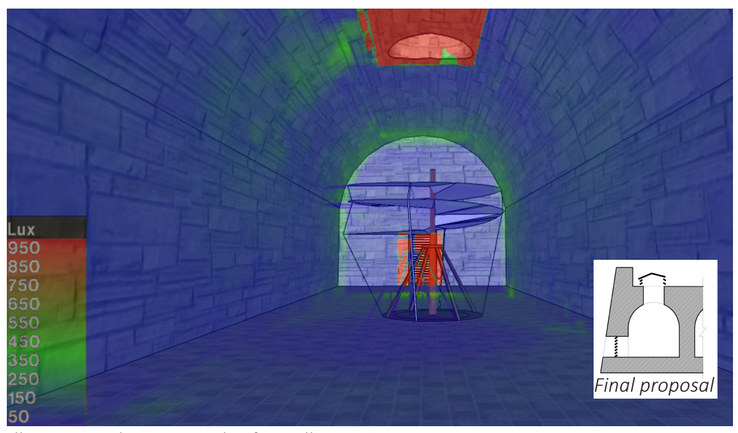




The best natural ventilation strategy was tested against the use of night-time ventilation with an alternative humidifier composed by silica-coated louvers inserted in the covers of the openings in the roof. Both strategies are effective keeping relative humidity below 70%, but the dehumidification achieves lower temperatures.

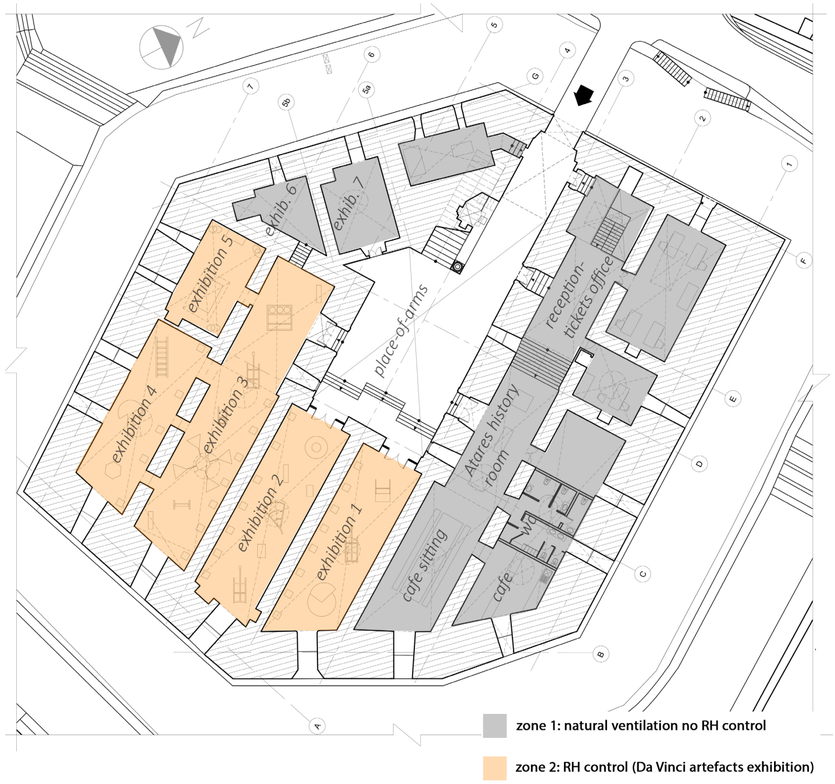
DAYLIGHT ANALYSIS



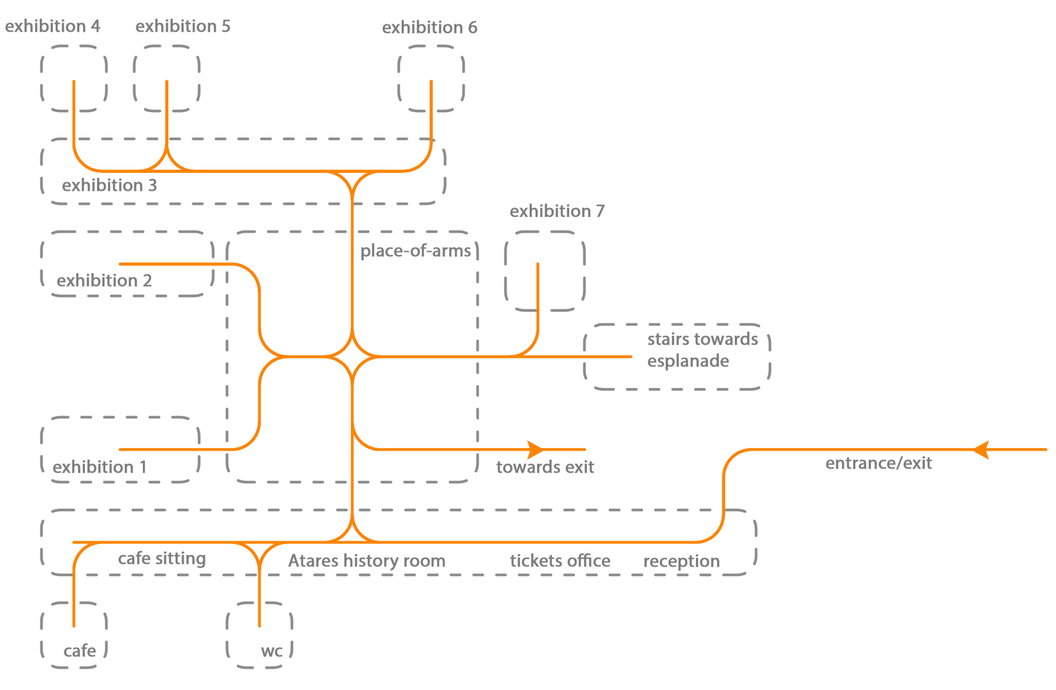


Illuminance during periods of overillumination

Outcomes



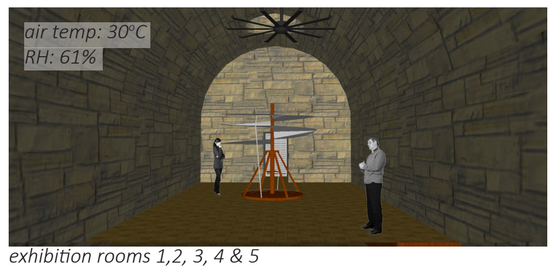
Zoning of the spaces in the castle to apply different strategies



Movement of the visitors in the castle

place-of-arms

reception/tickets office



exhibition rooms 1,2, 3, 4 & 5

Conditions of different spaces in the castle at 1pm typical day in August