

Outside, Around, Inside. New Paths to Discover San Michele Castle (Cagliari, Sardinia)

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Abstract. In the framework of conservation and enhancement of cultural heritage, accessibility plays a crucial role. Architectural heritage peculiarities call for specific approaches: the same care must be adopted to improve accessibility to historic architecture, designing actions case by case. Starting from these considerations, the contribution is aimed to discuss the accessibility of fortified architecture, a not easily accessible heritage, to make it accessible both in a physical meaning as well as in cognitive, cultural and social. Particularly, the authors propose some reflections about alternative ways of usability for inaccessible architectures due to their typological configuration and as a consequence of previous conservation design. The case study is the medieval castle of San Michele in Cagliari (Sardinia), which was transformed several times during its life and restored at the end of the 20th century. The contribution analyses how a multidisciplinary approach is necessary for the formulation of effective accessibility solutions, especially in complex cases such as fortified architecture. This multidisciplinary approach must be accompanied by the widest possible consideration of the causes limiting accessibility, whether they are physical or related to motor, perceptive or cognitive disabilities.

Keywords. *fortified architecture, cultural heritage, accessibility, ICT, design*

1. Un-cover (VP)

In the framework of conservation and enhancement of cultural heritage, accessibility plays a crucial role. It is well known that peculiar weaknesses of architectural heritage require specific approaches: the same care must be adopted to improve accessibility to historical architectures, designing actions case by case.

Starting from these considerations, the contribution is aimed to discuss the accessibility of fortified architecture, a not easily accessible heritage, to make it accessible both in a physical meaning as well as in cognitive, cultural and social [1].

Accessibility's degree of a place depends on relations between places and the people enjoying them: in fortified architecture, these relations can be seriously compromised since inaccessibility itself is an essential characteristic, fundamental to its inherent defensive potential. Fortified architectures express military strategies that inspired them through the close link between function and shape: shape follows function requirements; function is exalted in every architectural detail and becomes a recurring reference. This issue makes the study of accessibility in fortified architecture an interesting challenge since the designers have to deal with a variety of accessibility/inaccessibility degrees, to seek the most appropriate solutions for adequate usability while preserving places values.

The castle represents a quintessentially inaccessible place and the purpose to make it "accessible" through shapes, elements and spaces transformations could disrupt that

close link between function and shape [2]. That is to say, authenticity and typological identity, historical-cultural and architectural recognisability may be compromised by the ambition to meet the requirements of new functions while altering the inaccessible nature of castles. It is not intended to argue that it is impossible to act on a fortified architecture as if it is an immutable object out of time, but rather to highlight the greater difficulty to find deeply conscious solutions that take into account accessibility necessities and preservation needs of intrinsic values and meanings.

In this sense, a multidisciplinary approach is required to define successful accessibility solutions, which should be capable of encompassing the widest possible causes that are limiting accessibility. As the presented work demonstrates, a synergic collaboration between Restoration and Drawing disciplines played a crucial role in the definition of widespread knowledge.

The case study is the medieval castle of San Michele in Cagliari (Sardinia, Italy), located on top of the namesake hill, inside an urban park (fig. 1). It has been transformed several times during its life and deeply restored at the end of the 20th century. The castle is visible from all the surroundings, but it is not easy to reach the park due to a lack of road signs nor to arrive at the castle itself once entered the park. Moreover, concerning cultural and cognitive points of view, the architecture is difficult to understand because of the recent reuse design which deletes historical stratifications and adds an invasive modern structure to adapt the ruins of the ancient castle into a contemporary museum, and so on.



Figure 1. San Michele Castle, aerial view (E. Mannai 2021).

The methodology follows a traditional approach also developed with the support of new technologies [3]. Analyses aimed to define conservation design while focusing attention on inaccessibility issues, considering different scales, and physical, cognitive and cultural points of view. The first step was to collect data from indirect exploration, through archive, bibliographic, iconographic and cartographic recognition. In the second step, a direct survey was carried on through UAS technologies for external areas, and LIDAR and Panoramic Photos, for interiors (fig. 2). Analyses results highlighted several serious problems at different scales that couldn't be solved by single "unrelated devices" but need a deep redesign of the whole urban complex, starting from accesses and paths.



Figure 2. Architectural survey. Flight plans for UAS (on the left) and laser scanning stations (on the right).

In particular, the analyses highlighted an extensive variety of problems of accessibility and usability, related to mobility, perception and cognitive strictly, up to those arising from the lack of advice concerning the site and the ineffective communication tools [4] [5]. Therefore, the authors have proposed several solutions aimed to guide the user during the whole experience in the Castle of San Michele: starting from a new information system to reach the park and the top of the hill where it is located, up to the physical access into the castle with paths designed according to different users' needs. In addition, around the castle, tools such as information boards and AR apps are available to tell users about the castle's building transformation and the history of its owners and inhabitants (fig. 3).

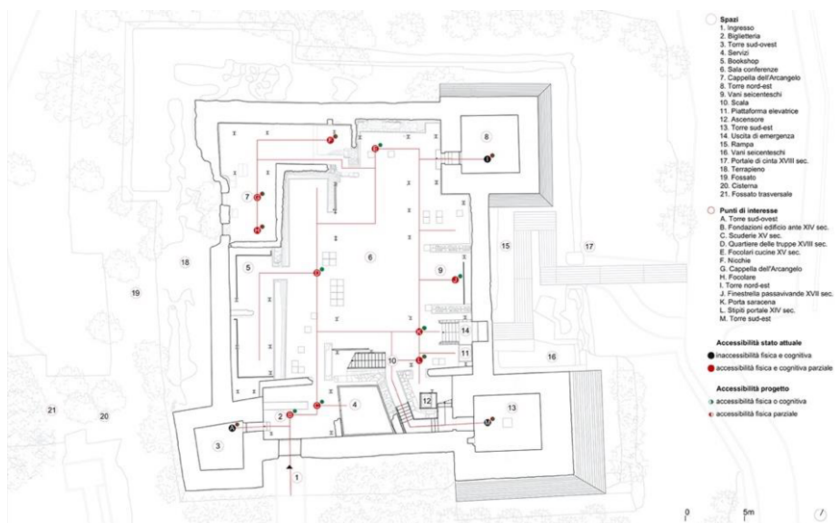


Figure 3. Architectural spaces, points of interest, the current condition of accessibility and new design.

2. Re-cover (EM)

The San Michele castle has been transformed over time by the functions performed: it was built as a fortified residence of the Carroz of Quirra family (14th cent.); then, it became an urban leprosarium (17th cent.) and later, back to a defensive use, it is renovated as a modern fort (18th cent.). Abandoned in the 19th century, at the beginning of the 20th century the whole hill is occupied by Military Navy and the ruins of the building are adapted to accommodate a radio station [6].

Several conservations work occurred: the purpose of the last one (1988-99) was twofold to arrest the serious state of decay of the castle and to transform it into a museum and the surrounding in an urban park. Specifically, the architectural project consisted of: archaeological excavations, consolidation and conservation works focused on the walls and the addition of a steel and glass structure inside the ancient perimeter to create a modern building (fig. 4).



Figure 4. The castle before the restoration works (1896).

Currently, the castle has a quadrangular architectural layout, with three corner towers and a surrounding dry moat. It is built using mainly limestone, which comes from the quarry of the hill, and lime plaster. Other materials were used in transformation and conservation works. The documentation analysis and the survey of the castle's current state allow for to identification of critical issues and specific needs regarding accessibility on different levels of intervention. On the urban scale, the mobility networks between the castle and the urban centre are disadvantageous, both in terms of public and private transport. Considering the castle inside the park, several critical issues are found due to the hill morphology: the entrances are not identified and marked; there is a lack of communication languages, particularly of multisensory devices, fundamental to support the accessibility of people with sensory disabilities. The paths show a dangerous current state: degraded pavements and several physical obstacles are present along with them. Several areas of the park are completely inaccessible due to the risk of landslides and rockfalls; basic services, adequate lighting and a security system are absent;

monumental components are unexploited. The elevators, located inside the park to ensure a direct connection with the castle, are out of use.

At the architectural level, the inside museum experience presents various problems, both physical and cognitive. The space of architecture is piecemeal due to its ruined state and height differences between the ancient courtyard, towers levels and the new upper floor, connected with stairs and an elevator. The contemporary structure interrupts vertically the space and makes a dimly lit environment that does not welcome visitors.

On the south front, access takes place along a short concrete walkway, which allows people to enter the castle by crossing the surrounding moat. On the east front, to reach the lower level of the gate, it is necessary to overcome a brief staircase, or to use an elevator platform; once out of the door, a tortuous ramp allows people to overcome the moat. It represents a temporary ineffective solution, made of wooden board and metallic tubes, built at the end of the 20th century.

Inside the castle, the reception and ticketing services are located on the ground floor, where people can find also the bookshop. Traces of the 18th-century walls are evident, although they are not valued nor adequately marked. The area of the courtyard is used as a conference room: when it is necessary, it can be closed off with movable panels. Along the inside path, there are panels with information about the history of the castle, written just in the Italian language. The second floor is an open space characterised by the presence of panels for exhibitions, an area dedicated to educational workshops for children and two looks towards the Archangel Chapel and the closing system of the eastern gate. The shape of the castle makes it difficult to create inclusive paths which allow all people to appreciate the site: for example, to visit the area of “Archangel Chapel” it would be useful to demolish historical walls; instead, access to the towers it is possible just passing along stairs, designed uncomfortably. At present the towers are inaccessible: the rooms are limited in access due to the lack of structural support so two of them are used as private spaces by the museum management.

Solutions proposed may provide alternative ways to link the castle spaces, aimed at better use of the architectural asset in relation to the size of the park and the castle itself. These solutions enjoy the use of augmented reality, digital technologies and multisensory tools, for greater physical, cultural and cognitive accessibility.

3. Dis-cover (RA)

As seen previously, accessibility issues range from physical to sensory and cognitive accessibility. Equally wide is the range of solutions that can be adopted to eliminate, or at least mitigate, these issues. Modern digital tools such as augmented reality or the use of virtual environments for the creation of tours are proving to be essential to ensure accessibility to historical architecture to an increasing number of users. Often these tools, however, do not provide a fully comprehensive and inclusive solution: on the one hand, the use of a virtual tour allows visiting a place physically inaccessible, but in some cases, sensory difficulties can limit or frustrate the benefits of this technology. Similarly, in the presence of particular cognitive conditions, the use of technologies that provide a high level of involvement can create confusion or discomfort in users. For this reason, solutions are proposed to combine digital technologies with physical tools, with the aim that one type can compensate for the shortcomings of the other [7].

A first example can be seen in the approach to the castle through the pedestrian paths; along these, the installation of information totems has been hypothesized (fig. 5).

The totems, while walking along the path, offer a story of the castle and its context; they have three components: a transparent panel on which various information is impressed, a tactile map with the same information and a QR code which makes it accessible additional information [8]. The transparent panel is designed to offer a sort of augmented reality simulation; by standing in front of the panel, the user sees the castle through the panel, and the information it contains overlaps with the vision of the castle, "augmenting" it. Using the QR code, it will be possible to offer further experiences such as the vision of the 3D model of the Castle, thus offering new points of view for most users, or the listening of audio information to support users with visual impairments (fig. 6).

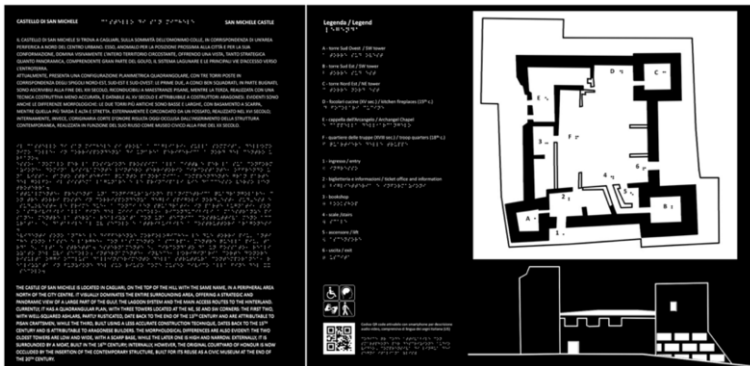


Figure 5. Illustration of the “welcome” totem: it is designed to be located near the entry of the castle.

Since the survey phases of the castle have included the use of laser scanning, the point clouds generated by the latter can be used to create 360° panoramic images with which to develop a virtual tour of the castle and the surrounding area [9]. Through the use of dedicated tools, such as game engines [10], it is possible to import the spherical photos and connect them through interactions to create simple tours inside and outside the Castle; this type of application allows the visit of the monument even when, due to physical limitations, it is not accessible. Moreover, the creation of a visitable virtual environment allows the user to access additional notions and information, enriching the experience; in fact, it is possible to implement further interactions that allow the reproduction of narrative media, the opening of information panels or the overlay of graphics with additional content on the screen. Similar experiences can be offered through the use of augmented reality. An example is the already mentioned system of QR codes impressed on the external totems, from which it is possible, through a special app, to visualize multimedia content. Through a careful arrangement of markers inside the Castle, it is possible to enrich the physical reality with new information directly superimposed on the real object to which they refer; in this way it is possible, for example, to show the history of an artefact or a part of the monument, to offer simulations of how the space could be before the restoration works or how it could become after new works. In addition, all this information can be filtered or calibrated by taking into account the users, in particular their age, their level of education, any sensory or cognitive problems etc.

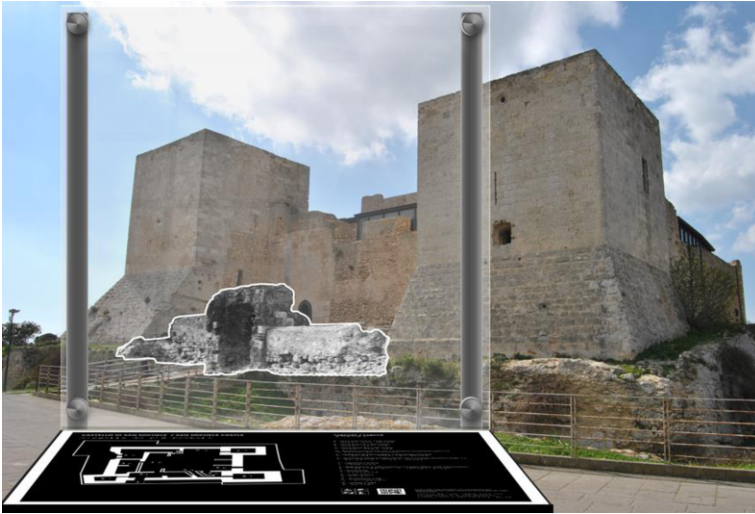


Figure 6. Transparent panel for augmented reality simulation.

Another interesting possibility is that of visiting, through augmented reality, nearby but inaccessible spaces; in fact, it should be considered that virtual access to the Castle is not necessarily an alternative to the physical visit, but it can complement it to offer a better experience to users and consequently enhance the monument itself. Some parts of the Castle require access through passages that make it difficult or impossible for certain categories of users to pass through. They find themselves close to a space they want to visit, without actually being able to access it; through the use of augmented reality, it is possible to virtually remove obstacles, such as a wall, to show what is hidden behind it, simply by framing the obstacle with a portable device (fig. 7). The proposed solutions are just a few examples of how the monument could be made more accessible to all users, to remove any limitations.

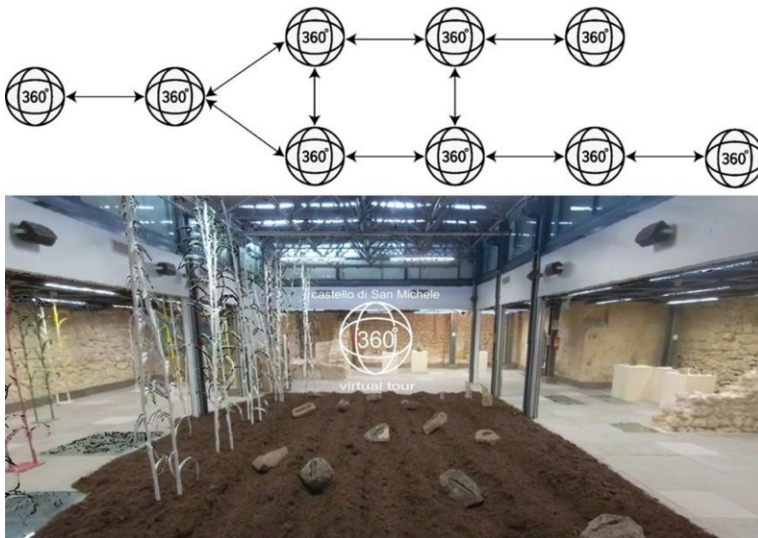


Figure 7. Screen captured from virtual tour application.

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