



The Environmental Contribution to Wayfinding in Museums: Enhancement and Usage by Controlling Flows and Paths

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Abstract. The field of research in which wayfinding is situated refers to the way people move in reaction to environmental stimulation. It therefore fully concerns not just signage but also space designing, its geometric configuration, technical solutions and their material characterization. The focus is consequently on environmental factors that facilitate wayfinding in a museum (accessibility, visibility, etc.) and on other elements such as spatial configuration, architectural features and functional aspects. These factors influence relational phenomena and therefore visitors' satisfaction. Methods and tools for designing and managing spaces have been studied in the research. The configurational analysis method of space has been used to objectify syntactic features of space. In particular, the outcomes of an experimental project, which have been analyzed in a master's thesis on the re-functionalization of the museum of Palazzo dei Diamanti in Ferrara, are presented. Permeability, proximity, connections of spaces, namely meaningful features to ensure wayfinding have been examined. Space parameters resulting from the geometry of the layout, from the visual connections and from the changes of direction were then evaluated. The outcomes have been used as inputs for designing a unitary tour route circuit, that also reconnects the museum's second floor, and for planning three independent alternative routes for a differentiated use of the museum.

Keywords: Wayfinding · Museum · Configurational analysis · Space syntax

1 Introduction

1.1 The Environmental Contribution to Wayfinding

Decisive factors that make the wayfinding project effective concern the ease with which space can be decoded and “read” by users, also thanks to the use of environmental stimulations addressed to various sensory channels, and which provide in a coherent and organized way all the necessary information for the museum to be usable, welcoming and safe even for those who enter for the first time. In fact, thanks to a well-done design that maximizes the level of environmental communicability, it is possible

to improve cultural and environmental accessibility and to reduce the “visitor’s stress”, namely the gradual loss of attention towards the exhibition due to the mental fatigue of the user who is too busy making decisions on where to go inside the museum.

The field of research of which wayfinding is part of therefore concerns the way people move in reaction to environmental stimulations [1]. Hence, it fully concerns the designing of space [2], technical solutions and artifacts. It is not only about communicative systems, but also spatial configuration and material characterization [3]. Environmental factors that simplify wayfinding in a museum (accessibility, visibility, etc.) along with other elements such as spatial configuration, architectural features and functional aspects, all influence relational phenomena [4] and therefore visitors’ satisfaction [5]. The aim of the proposed contribution is to deepen the knowledge of the spatial layout of museums and qualify, by measuring it, the integration between its various functional areas in order to improve wayfinding and fruition [6]. For this reason, methods and tools for monitoring, evaluating and verifying flows are proposed, with the aim of managing and designing museum spaces. The study focuses on the proximity relations between spaces, on hierarchy in circulation, on the differentiation of routes, on the legibility of accesses, on journey times, and on the control of personalized exhibition routes. Methods and tools in support of space design and management have been studied in order to improve visitors’ flows. One of the most used methods is the analysis of spatial configurations, also employed in the research by using the software *depthmapX* [7–12]. It is a method that makes the syntactic characteristics of space objectifiable and that has been applied in several museums (British Museum [13], Victoria & Albert Museum [14]) with the aim of improving their use. The results of the configurational tests carried out in the mentioned examples led to the replanning of wayfinding strategies, with consequently an optimization of the different museum areas and a relaunch of the image of the museums.

This paper, in line with what has already been experimented at a methodological level, reports the outcomes of an experimental project that has been analyzed in a master’s thesis on an emblematic case study: the re-functionalization of the flows and routes of the Palazzo dei Diamanti museum in Ferrara, which aimed to optimizing ways of use and journey times in relation to the possibility of dividing the museum and the exhibition spaces depending on the features of consistency and interest of temporary exhibitions (functional lots) [15]. By using *depthmapX* (configurational analysis) some significant properties of space were identified in the interest of way-finding (permeability, proximity, connections). It was possible to give a value to each element of space according to its connection with other spaces, the permeability with adjacent spaces and the proximity to the entrance (information point) [16]. Space parameters resulting from the geometry of space, from the visual relations, and from changes of direction of the layout were then evaluated. The results have been used as inputs for re-designing a unitary tour route circuit (sequential structure), that also reconnects the museum’s second floor which is now separated, and for planning three autonomous sub-rings that represent alternative uses of the museum.

2 Case Study: Enlargement and New Functionality of Palazzo dei Diamanti in Ferrara

2.1 The Topic of the Project

The general aim of the proposed experimentation concerns the potentials of wayfinding to enhance museum spaces, as a discipline integrated to designing, in order to influence the quality of the visit and the overall satisfaction of the visitors.

The experimental project focused on the Palazzo dei Diamanti of Ferrara, the most important work of Ferrara's Renaissance architecture and for which the city announced an international design competition [17]. Currently there are three different museums in the Palazzo: the National Art Gallery, located on the main floor, the Galleries of Modern and Contemporary Art, within the two historical wings of the ground floor, and the Museum of the Risorgimento and the Resistance, in the southern area of the complex (Fig. 1). The latter will be transferred within a few years to a new location (designed ad hoc) in order to free spaces that will be requalified and allow the enlargement of the Galleries of Modern and Contemporary Art in terms of exhibitions and provided services. The invitation to tender was based on the necessity to provide the structure with supplementary services that are currently missing and to adapt the visit route, which is currently not very functional, to contemporary museum standards. In fact, the exhibition route of the Galleries of Modern and Contemporary Art is within two wings of the Palazzo (called "ala Biagio Rossetti" and "ala Benvenuto Tisi") that are separated and not contiguous and which conjoin with an outdoor "platform roof". Consequently, one of the main issues in the request of proposal was the design of a new air-conditioned connecting unit between the two wings of the building that could also be used separately and independently from the exhibition route to be able to host big events and conferences and to exhibit large format works of art.

2.2 Analysis of the Current State of Affairs

To develop such an articulated Construction Plan, in compliance with the building's tutelage requirements for its historical and cultural importance, wayfinding problems were studied as a strategic aspect for the re-functionalization of the entire complex from a point of view of the reorganization and hierarchization of spaces and the necessary usability. Which are the tools that the architectural plan can use to make buildings more hospitable and easily decipherable for someone that has never been there?

Configurational analysis represents a supportive tool for planning decisions. Starting from a careful analysis of the current state of affairs, both from an environmental and technological point of view to understand the potentialities of the spaces and the feasible intervention levels, the planimetric and spatial configuration was checked by considering and prioritizing the systems of flows inside the building. Subsequently, different interventions were suggested to characterize the areas from a material point of view by working on the perceptual and sensorial properties of the architectural elements (finishing materials, furnishing, devices). Also used was the application of methodologies of numerous international examples of improvements and upgrades of very complex museum spaces based on scientific and objective support for

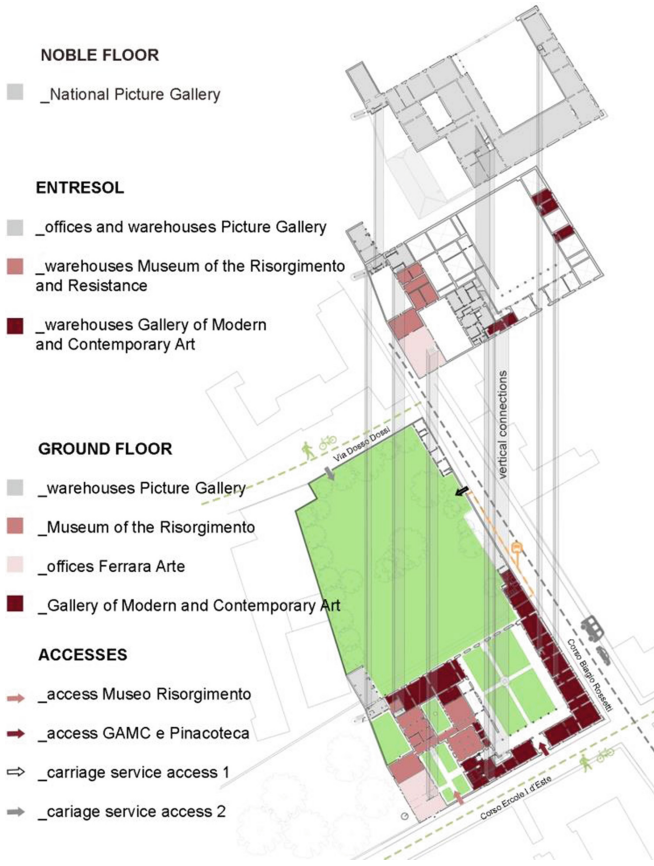


Fig. 1. Functional subdivision of Palazzo dei Diamanti, current state.

the verification of project choices. The software used, made available by the University College, was depthmapX which can analyze the spatial configuration and was useful for carrying out an initial verification of the project choices. The verification provided a first representation of the building through a graph that identifies convex spaces (environmental units) as nodes and their direct relationships as connecting lines. In this case, the construction of the graph highlighted the predominantly sequential connections of the wing environments destined for exhibition areas, which therefore would require the user to follow a progressive-linear tour. Starting from the graph the successive levels of analysis led to the measurement of the level of connectivity of each environment, that is, for a given space, the maximum number of spaces adjacent to it. Repeating this calculation for each space it was possible to measure the degree of integration of the convex space by adding the distances from the latter to all the other nodes. The software made it possible to qualitatively appreciate the results by coloring in warm colors the best integrated spaces and in blue those that could be reached only with a greater number of passages, see (Fig. 2). It should be noted how, in the present

state, with the distribution elements most connected to the different environmental units, there is therefore no central “core” inside the building, rather two main routes, one of which leads outdoors, which is not very convenient especially in the winter. Even through the analysis of the “HH” spatial integration, it can be seen how the distribution axes are more integrated than the rest of the complex, nevertheless access to the rooms to the south of the building (where the request for the proposal requires the new services for the public to be installed) is easier than the north exhibition wing. This means that the required reception areas, cloakrooms and toilets end up being poorly integrated. Continuing with the application of the verification tools, we abstract the space by means of a point grid from which it is possible to calculate the visual integration i.e. all the points of the grid that are mutually visible to each other. Again, the most visible spaces are in red and the most hidden in blue. From this, it is clear how the new services areas, given their position on the lay-out, are visible only from specific positions, so their presence would not be perceptible to visitors without specific signage. Where the warmer colors are, on the other hand, the portico has maximum visibility compared to the rest of the building, a feature that makes it appropriate to be the first reception point, where the visitor could find the first signs on possible routes to take.

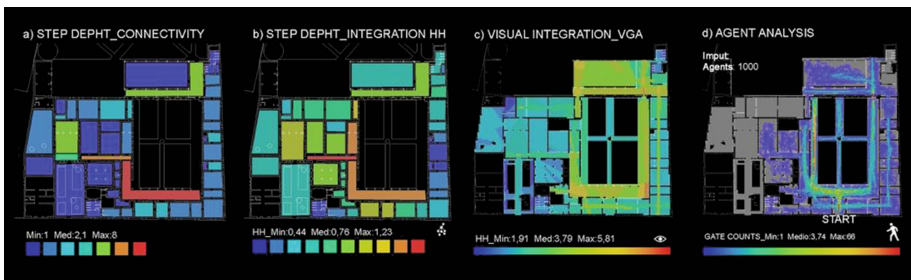


Fig. 2. Space syntax analysis (with depthmapX) of ground floor of Palazzo dei Diamanti, current state. (a) Connectivity (b) Integration HH (c) Visual integration (d) Agent analysis. (Color figure online)

The visibility graph (Fig. 2c) is also fundamental for another type of analysis because this is related to the movement of people in space. In fact, the results of this type of calculation simulates the flows within the space through the “agents” or entities capable of perceiving the space surrounding them to make the predicted decisions based on statistically expected human behavior. In the simulation the agents started from the main entrances of the building in numbers proportional to the flows of people observed in reality; each agent can choose a direction of movement (action) based on his visual field (perception) derived from the analysis of visual integration. The layout is broken down by a uniform grid and for each agent occupying a given square of the grid, the next destination is randomly selected among all the visible squares within a visual field view cone (the angle is generally large, i.e. 170°), giving the agent the opportunity to change direction. In the case study of Palazzo dei Diamanti the process

was repeated 10,000 times. From the results obtained it is observed that different areas of the ground floor are less frequented by the agents, as they are less visible. In particular, it is possible to notice how, using the current access to the Modern Art Galleries, as indicated by the invitation to tender, agents are not “spontaneously” able to reach the premises where the new services will be installed, thus such results do not support the original idea (given in the invitation to tender) for a convenient and integrated usage of all areas of the building.

To summarize, by applying these analyses to the current planimetric configuration of Palazzo dei Diamanti, several critical issues have emerged: the most integrated and connected spaces are those of distribution, one of which is the uncovered portico, and the other a connecting space, which is quite narrow. The analysis of the agents also shows how, by accessing the historical entrance, due to the lack of visibility of the areas destined to new services, it would be statistically unlikely, for an individual who has never been in the building, to “spontaneously” find the museum visitor support services. These results have been decisive for setting up a project that proposes an improved alternative in response to the invitation to tender, starting from the study of the individual environmental units present inside the building and assessing the environmental characteristics of usability, visual wellbeing, transformability, connectivity and visibility, to the in-depth analysis of the technological system and the heterogeneity of the technical solutions present in the building. These analyzes have further highlighted how within the museum an intervention was needed to even out the accessibility of the various parts of the building so that they are accessible for all types of users.

As far as the aspects the wayfinding are concerned, the imbalance between the two entrances is evident: the Modern Art Galleries’ entrance, already stands out for its characteristic sculptural façade, while the Museum of the Risorgimento and the Pinacoteca are much less noticeable from the outside.

2.3 Meta-Project and Proposed Interventions

A meta-project proposal was thus established for the main entrance of the museum to be the functional reception area. Moreover, this area, taking advantage of the courtyard as a full height space, would represent a new main entrance point for the Pinacoteca, leaving however the possibility of using the previous access through the historic staircase (Fig. 3). In this way it will also be possible to organize around the new access/InfoPoint the spaces for supplementary services available to users at the beginning and end of the exhibition itinerary. To avoid the inconvenience of passing through the open portico, the proposal foresees its closure through a system of continuous glazed facades.

Following the indications of the invitation to tender that required the construction of a multi-purpose pavilion that connected the two wings of the building, some alternatives for positioning the new pavilion were tested. The proposal recommended placing and organizing it to be contingent to the rest of the building, while allowing an air-conditioned and covered passage between the two exhibition wings.

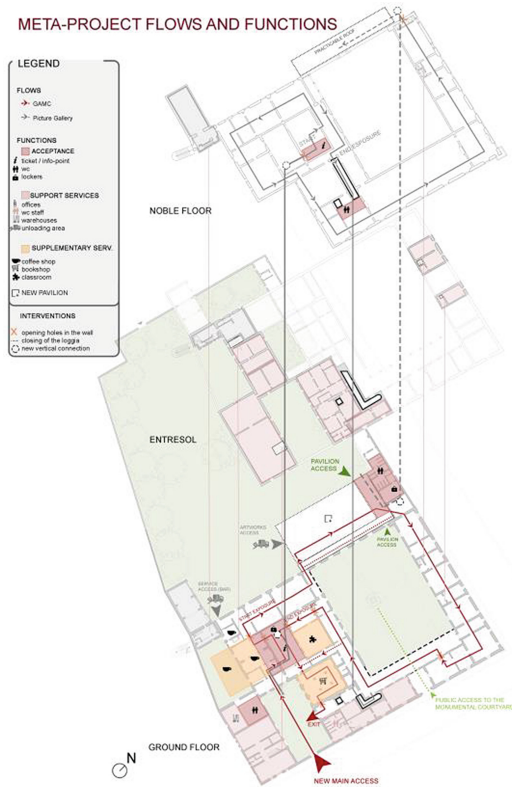


Fig. 3. Meta-project of flows and functions.

The exhibition path will thus be able to end where it started: inside the courtyard that will be covered, as required by the invitation to tender. Finally, the exit from the museum will finally be placed at the bookshop.

2.4 Verifications

Repeating the configurational analysis (depthmapX) has confirmed that these solutions maximize the integration of the new “core” designed to welcome visitors. Additionally, having agents start from the new proposed entrance, it allows them to complete the itinerary “autonomously” (Fig. 4d), as opposed to the first simulation.

The analysis of the integration (Fig. 4b) shows how it is necessary to make it possible to use the open gallery or main walkway also in the winter, given that it is necessarily part of the museum itinerary and a high level connection between the parts. By moving the entrance to the support service area the museum will also have a new center of gravity that will allow for a simpler distribution of the different sectors. This operation will make the area intended for the new services more integrated: therefore it is here that it is proposed to insert a new vertical connection to the picture gallery at the

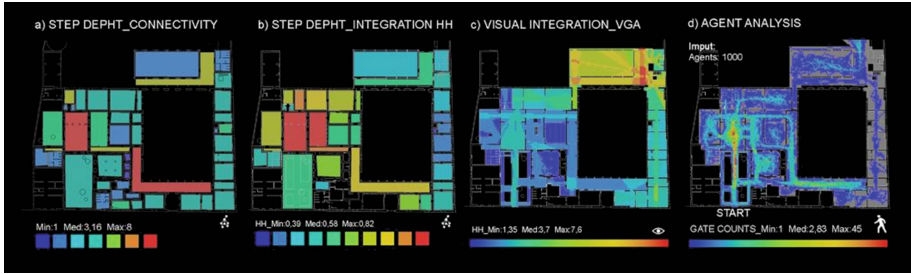


Fig. 4. Space syntax analysis of ground floor of Palazzo dei Diamanti.

noble floor, using the court to its full high. Qualitative observation of the graphical analysis of visual integration (Fig. 4c) shows that the new entrance to the newly built pavilion will reach a high level of visibility. Opening new spaces that are presently still closed inside the walls will generate different visual axes that will allow visitors to find their way around more easily, allowing them to reach various areas that today are less visible.

The last simulation, which refers to the agents' use of planimetric space (Fig. 4d), shows that, thanks to the proposed layout, the distribution spaces will end up being a lot less crowded, while the highest concentration of people will be in the welcome areas, as it should be.

Later the possibility of the exhibition rooms being used in a fractioned way by organizing a division into “functional spaces” was looked into, since the ground floor is intended for temporary exhibition: they can be used in different ways according to the nature and size of exhibitions. Every functional space is independent, and potentially could have its own welcome area by using the various possible ways into the building (Fig. 5). As a maximum complexity configuration, it was supposed the simultaneous use of several routes, such that all start from the same access point and end in the same spot. More specifically, the type A scenario schematically represents the situation in which access to educational, dining, and commercial services, is considered. This scenario takes into account the potential lack of temporary exhibits. The type B scenario would instead occur when an exhibit is held only in the Biagio Rossetti Wing, but integrated services could still be accessed at the end of the visit. The third layout illustrates how it would be possible, thanks to the multiple access points, to use the Gallery even when the ground floor is not used. Even the new pavilion would be accessible through its own entrance, separately from the rest of the building.

The last layout represents the simultaneous use of the different routes inside the museum. Thanks to the barycentric position of the new welcome area, it will be possible to host at least three different temporary exhibits without compromising the accessibility of the noble floor.

Environmental and technological requirements were defined in accordance with the organization established in the meta-project on flows, so that the building might be adapted and transformed for the project's requirements. Since the pavilion is a new construction, several possibilities of aggregation of the environmental units necessary for its functionality were explored and considered upgrading the building's historic

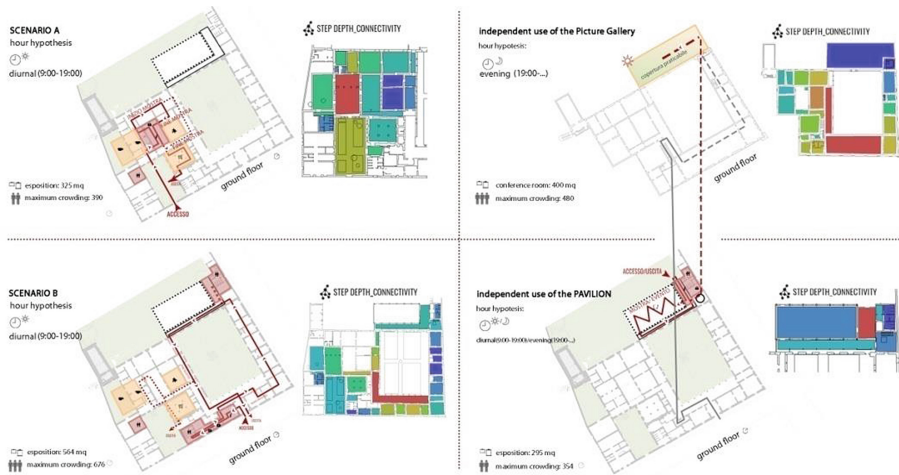


Fig. 5. Meta-project of alternative sub-lots and checks with depthmapX.

wings. The chosen configuration will allow for a flexible use of the inside space, meeting the grant's requirements of hosting large-scale art-work, as well as widely attended events and conferences. The renovation works were listed in order of priority, from those necessary for maximizing the museum's accessibility to those that would guarantee its greatest functionality.

3 Conclusions

The case study of Palazzo dei Diamanti of Ferrara showed how the configurational analysis has made objective a series of critical issues found in the museum's usage and supported the formulation and the hierarchization of the project objectives. By using the same kind of analysis once the proposed layout was verified, we were able to qualitatively assess our choices. This process supports the notion that solutions that facilitate wayfinding inside complex spaces have positive impacts on the accessibility of the entire building, as long as they are conceived in a holistic way from the start of the planning process. The proposed analyses and verifications aided the design of the functional layout and guided the technical choices to satisfy the invitation to tender requirements. However, this is only an initial but fundamental step in actualizing wayfinding. Not enough work has yet been carried out for the space to be communicative and easily read by its users. For this reason, the next steps of the project focused on the material characterization of the different functional areas. Each area's distinct characteristics were made clearer for anyone experiencing the museum by developing specific superficial coverings (especially flooring), and by choosing furnishing that, through color codes and matrices, organically increased the space's ability to communicate with all other present elements.

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