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Sharing knowledge, grasping Cultural Heritage: a digital multidisciplinary approach to the historical process of architecture and urban changes

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Abstract

Digital tools are changing the way of Cultural Heritage is shared and understood in society. However, the key to improve truly the common knowledge about Cultural Heritage could be especially in a multidisciplinary approach in research and in the dissemination of its outcomes.

The paper focuses on a multidisciplinary approach by involving Urban and Architectural History, GIS and 3D modeling. It discusses how new technologies especially help in reconsidering the state of the art and in making understandable the historical process of architecture within the changes of the city.

The authors present this approach applied to a range of 19th and 20th Turin Cultural Heritage, at architectural and urban scale: the large range of buildings designed by Alessandro Antonelli and the destroying and rebuilding of a street with homogeneous front, via Roma, in the Thirties.

Research uses GIS, 3D models and digital platforms in order to visualize changes also making visible ideas and designs never realized. Digital platforms link buildings and urban areas to drawings and documents preserved in city museums and archives. The aim is to make truly accessible both historical information and different kind of Cultural Heritage.

The conclusion is that this approach to the historical research could improve a wider access to the Cultural Heritage by enhancing the perceptions and the understandings of the relationships between buildings within the cities, also revealing the Cultural Heritage in archives and museums.

Keywords: Digital History, 3D model, GIS, Multidisciplinary, Access Tangible Cultural Heritage

1. Introduction

Digital tools and web 2.0 have changed definitively the way to access the historical information, disseminating any kind of data about the worldwide cultural assets. The strict connection with cultural tourism and the UNESCO care in listing and explaining the motivation in classing world heritage also boosted a wide audience in checking information and learning about places, buildings, or intangible assets.

New directions in museums also contribute in changing the way to exhibit art and history in order to involve visitors by immersive spaces, exciting set up and digital displays. This approach of museums as a place “to preserve, to study and to communicate” (instead “to collect and to conserve” as priority) was among the early changes aimed for the inclusion of the larger community by using mass media.

Nowadays the potential of digital environments are pushing toward new challenges that are looking for the interaction with people. The community is asked to contribute personally in the sharing the Cultural Heritage for instance by supporting cultural activities, and above all in an individually experiencing stories and consciousness. By digital displays, everyone may put him/herself to the test about his/her skills and expertise, as well as they can choice what he/she is more interested in.

By this approach, people are engaged in building up their own attachments to the identities and cultural memories and in providing their collective evidence. On the other side digital environments documenting the cultural heritage also have the target to offer everybody the cultural tools to truly understand meanings. In this way the digital approach boosts in sharing the knowledge with society as well as in making understandable the heritage.

2. Architecture and urban contexts comprehension

Architecture is a relevant part of the tangible cultural assets. Buildings and built environment at large represent in a very strong incisive way values and meanings of the heritage. Siting within cities and historical landscapes they contribute to learn just moving in open-air museums, by creating immersive space.

This visible experience is very important but it is not enough to achieve a full knowledge about their history and its significance. Most of them also changed a lot in the centuries, and the relationships with the urban space could be very different in the present environment.

Studies and research refer about interpretations providing documentary evidence of different shapes, uses, and whatever. They are mostly addressed to select readers specially involved in the academic fields. Captions and figure of architectural drawings are asked to demonstrate the beginnings, the changes, the reasons. This process could be also more difficult to show and to documentary provide in the case of the urban space.

The general impression of the continuous change of cities is related to a wide range of phenomena and causes. The process of urban change mostly depends on the change in the topography, in the plan structure, in the open public spaces, in the buildings with their formal shape and their different functions (not necessarily but sometimes organized by orders and typologies), as well as in the social uses and in the architectural peculiarity of the space. Actors, patronage and creators play also a relevant task in the historical readings.

By traditional disciplinary approach, iconography is the instruments able to illustrate the stories. Nevertheless, architectural drawings, plans, cartography are not easily understandable by everybody. Special skills are needed "to read" through a dimensional representation system and especially 2D drawings (e.g. maps, plans, sections, and elevations) are quite difficult to interpret for not specialized people.

2.1 From tradition to digital solutions

No doubt, that 3D rendering opened a new access to architectural plans. That way they have started to be used also with an historical aim in order to visualize the Cultural Heritage. Therefore, a larger audience access information also encouraged to take an interest in cultural assets. Most among these 3D models reproduce the existing buildings by using the platform to explain. 3D images are conceived by a complementary connection with texts, not so far than the traditional approach does.

In a way, many digital environments for Cultural Heritage are acquired by translating in numeric data the usual written story. Nevertheless, this use of digital environment is very poor in front of its potential yet.

Digital tools (e.g. GIS, 3D modeling, and hypertexts) have to be used from the beginning of the research to ease the understanding of architectural and historical events by looking for a correct balance between technical solutions and conceptual contents. The "over exposition" of technical solutions without considering the real aim of the research can cause misunderstanding and incomplete or non-correct transmission of the real contents of the sources and of the interpretations made by historians. Therefore, "astonishing effects" have to be avoided if they are not able to transmit the real information useful to understand the origin of the analyzed data and the way they are used to reach the proposed interpretation.

The revolution created by digital age is much more permeating than that, and it allows rising to the occasion of a new open-mindedness. If "since its emergence as scholarly discourse", history has been strictly related to the written texts as well as these ones were linked to the sources that are traditionally transmitted by written records, the ICT revolution also drifts historical approach toward the visual world [5]. The originality of this approach could be precisely in a different relationship between image and text, especially suitable for history of the architecture and cities conceived under the point of view of the physical space. By using images digitally produced, also the outcomes of research could be translated with the exit of a fully dissemination. In addition, images make more understandable complex historical process improving truly the common knowledge.

This sort of "freedom" transcending the linear structure of the written (or spoken) text could have very strong consequences if fully achieved [2]. However, it could not just be reach by introducing 3D models or other digital environment as figures. The new developments can be expected by changing mentality that is the gaining a stronger digital approach.

Historical processes of the architecture need to use smart digital environments since the research survey up to the outcomes, and their public uses for the Cultural Heritage.

In a way, the historical process is to be approached by a multidisciplinary team. The collaboration of different specialized skills in fact is essential in creating digital displays suited for historical meanings of architecture.

This approach forces the specialists to reach a common work process and the upgrade of the individual skills by considering the milestones of the different disciplines and by looking for possible solutions to obtain an acceptable scientific strategy.

A correct balancing of the expertizes is the only possible way to merge the different competencies: historians have to understand the limits and the possibilities offered by IT solutions while technical researchers have to adapt the instruments (e.g. acquisition and management digital tools) to the preservation of the original contents avoiding simplifications and/or incorrect management of the sources and of their interpretation.

The main goal of an interdisciplinary research is the preservation of the transmission of the research, which means a correct presentation of the original data, the correct "lineage" of the data processing by ensuring the possibility for the reader to replicate the complete research path.

2.2 Digital research and dissemination

The history of architecture is a process always based in a space and in a time. The organized information, by databases, has to link data to that space and that time. Nevertheless unlike the architecture has been presented by 3D modeling, the territorial data has been surveyed by GIS especially useful to *spatialize* historical information [1].

The design of the database is one of the most important steps and only a common effort by all the specialists involved in the research allows an efficient and effective planning of the basic activities: source collection, source analysis and interpretation, and visualization and transmission of the results.

The database is the IT instrument able to connect data of different origins and to localize them in a common reference system in order to connect each data in the specific spatial framework where each data can assume deeper meanings.

The organization of an historical research is not a new but the adoption of digital tools to record all the phases of the research force the specialists to modify the acquisition and elaboration strategies. At the same time the digital recording of the data from the beginning, open new possibilities of analysis and new possibilities to transmit the systematic procedures, which can describe how the data have been interpreted.

Usually the software used in this kind of applications require high levels of expertise which are different from the ones useful to interpret the data. Therefore, the historical research is transforming itself in a multidisciplinary activity where each specialist has to play his proper role at the maximum possible level to be able to manage the foreseeable adaptations of all the used techniques.

The main mistake to be avoided is the technical overpass over the historical requirements. It must be stated that IT technologies have to facilitate historical research and possibly enhance them and not the opposite.

The conclusion is that many different tools can be exploited. However, in the aim to achieve truly shared knowledge digital technologies have to be shaped as tools improving both research and understandings.

The ICT experts do not need to make cryptic their implementation or the readings of their application by showing all the detailed potential of technologies.

At the same time, historians need to believe in a public use of history also aimed to improve the common knowledge. That way the visual interpretations coming out from data go beyond the state of the art crossing disciplinary fields.

3. Turin in 19th Century

The first research presented applies the digital multidisciplinary approach at different scales of cultural assets in Turin, architectural and urban.

The study deals with the city after loosing the walls and growing up in the 19th century. The key of this reading is identified in the work of an architect, Alessandro Antonelli, as the city archives are very rich of his drawings. His personal archive of sketches, designs and details' studies, in fact, is also completely well preserved, as it was gift to the city government by his son Costanzo when Alessandro Antonelli died. Costanzo Antonelli would like by that to offer a philological completion of his father's masterpiece, the Mole (Fig. 1).

Although it is the symbol of Turin since it was built, this building actually is mostly the only one well known of the architect unlike he was very active within the city and in the region. His figure working as a professional for the middle class and making himself as an investor represents a period of the history, as well as his neoclassical style revised by using a mix technology that is the traditional masonry integrated with iron structure.

The strange dome was conceived to be the highest building in Europe but it was even only for few years until the Eiffel tower was up. Its shape with the classical order and its traditional techniques disappoints who believe the innovation came out from new materials and new techniques. It was just the monumental transposition of a conception of architecture that he practiced anywhere strongly believing in his idea of innovation through the continuity with the tradition. By this understanding, Antonelli deeply inspired many architects till the 20th century.

The range of information above mentioned could be for specialized people only or for somebody very interested in the architecture. They do not sound as relevant as a piece of common knowledge on Cultural Heritage that really needs to be shared.

Nevertheless a large part of the image of Turin is done by the inspiration of this architect as early controversial as shared now: the Mole first of all, but also many more common buildings typical of the 19th century districts of the city.



Fig. 1: The Mole Antonelliana in Turin

The Mole has had a lot of function as a monument or as a museum since the Jewish Community changed its mind to complete it as a synagogue. Now it is open to visitors with the setup of the national Cinema Museum siting there. No doubt, that it is still the symbol of Turin.

However, people take no notice that Antonelli signed more and more buildings too. Although in the nickname of the Turin symbol, nobody knows about Antonelli.

It sounds as a curiosity but it is about the identification of a large part of the 19th urban Cultural Heritage. Still existing buildings (mostly private housing spread in many districts) as well as many architectural drawings are the heritage. Drawings that are preserved in many different archives, museums and libraries form a Cultural Heritage just “invisible” to the most of people.

By this reflection, the digital tools can be the best way to make visible and understandable the Cultural Heritage originated by the Antonelli thinking.

The projects also light the city growth in the second part of the 19th century, when Turin ended to be a capital. Many buildings were constructed in the new areas, where he strongly contributed by plan proposals for the urban development too. He never realized many of these ideas. Nevertheless, all of them improve the interpretation of his relevant work as a whole.

3.1 Research strategies

Designs could tell a lot about very interesting stories for the collective memory and very effective ones for the understanding of the urban history. For instance through them it is possible to reflect about the resilience of this city at different times.

Nevertheless, architectural drawings need to be studied and shown for an immediate perception of their contents. They have to be related with the urban space and its changes. In this way they are linked to the space and the time. This approach allows people to recognize places of the present city.

Therefore, the research deals with the 3D modeling of designs of the buildings, both of the built ones and the unbuilt ones. The historical survey of the urban areas provides data about a wider portion of the space. The archive survey collects information about the building permissions of the plots.

The translation of 2D drawings into 3D models is not a task that can be automatized in some way because it needs intelligent interpretation of the data and intelligent organization of the digital data to respect the real content of the sources. The layer organization of the digitized model has to reflect the results of the interpretation of the original sources and the always-necessary integrations able to solve the lack of 3D information. Data coming from historical sources and data coming from personal interpretation have to be presented in a different way (e.g. recorded on different logical layers) to allow the final user to understand what is objective and what can be discussed or considered with a different level of importance.

Data are managed to realize a detailed 3D model of the entire block. Many more information have been collected such as information about owners, functions, transformations or, in certain case, about the project realized instead of the Antonelli’s proposals. The aim is to gain understanding of the process of the architecture within the urban changes.

Franco Rosso specially consecrated many years to study and to catalogue all different projects, collecting records in more than a book [4]. The traditional approach is very important to carry on in-depth analysis by scholars. But it is not at all useful for grasping the significance of this work by everybody. Although these previous surveys are essential to broaden the research field to the whole

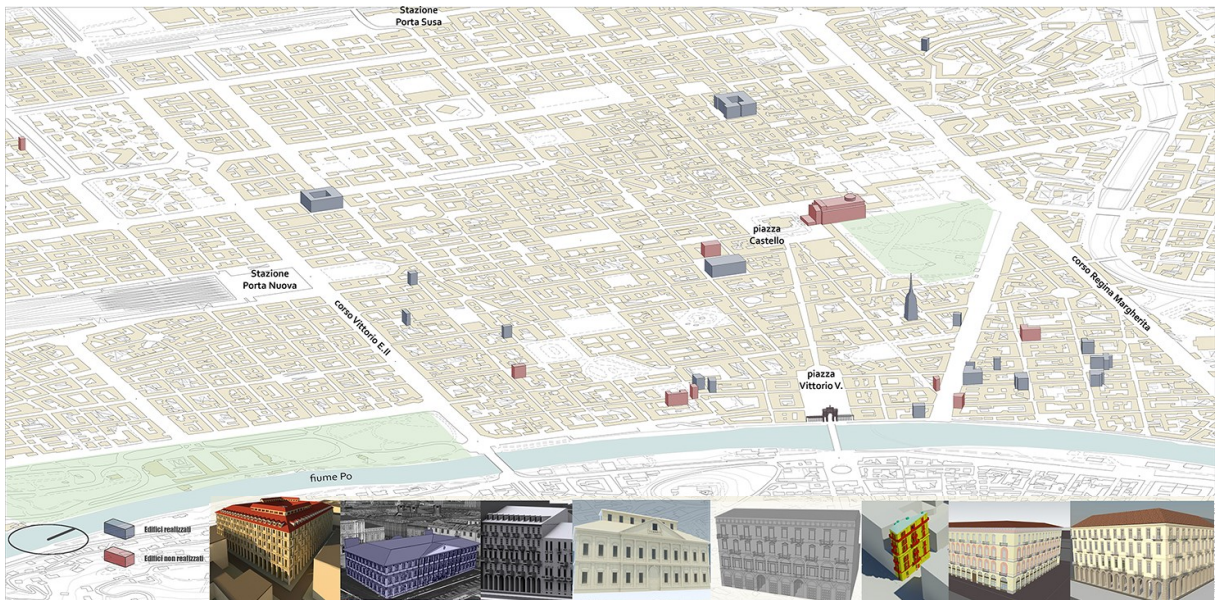


Fig. 2: Thematic map of the Antonelli's designs in the center of Turin

of his drawn work, the digital approach can create a new condition both for the research and for the common knowledge on the Cultural Heritage. The previous outcomes are used to create a GIS visualizing in a large territory all the projects.

The Turin GIS has been especially developed and is in progress now in order to link a database of all projects. The GIS is visualized by a synthetic overview of the nowadays Turin where each 3D models is placed (Fig.2).

The realized GIS uses different features: points for non-realized designs and polygons for existing Antonelli's buildings. For each of these features a specific set of attributes has been defined by translating existing classifications of the Antonelli's designs [4] and by adding the links to the existing digital archives of the original drawings or to the digitization performed of the material not yet transformed in a digital accessible way.

The drawings are the links to the 3D models realized for each existing or not existing building that can be accessed by the users. Finally the 3D model are linked to the GIS structure by realizing in that way a "logical circle" that allows the possibility to explore the historical sources and the basic results of the research in a unique platform.

The 3D modeling in the research is conceived to visualize different information. The architecture mainly is visualized as a process starting with a conception by drawings, sketches, variations and taking place within an urban area at a certain time, finally transformed later or under construction. The virtual architecture is mixed and compared with actual buildings in order to underline in one time the strong complexity of the process of architecture and its involving the everyday life (Fig.3). A grasping understanding of some projects never realized is obtained by visualizing them in the supposed area in order that everybody can fully estimate the range of the ideas (Fig.3). Some of these also disclosed fruitful comparisons with its greater inspiration of the Mole.

This is the case of the large scale of ephemeral triumphal arch he designed for the entry of the king Carlo Alberto, as well as his for the first academic project for the main square of the city (Fig.3).

In this case historical or recent photographic images can be used as a basic scenario: by knowing the coordinates in a specific coordinate system of some points, it is possible to recover the geometric parameters of the central perspective of the photographic image.

The 3D model of the design is than prospectively projected by using the above-mentioned parameters and inserted in the correct place inside the original image. The use of historical pictures allows one to understand what the architect imagined during his design while the use of recent picture allows one to see in which way the urban context could be modified in case of the realization of the design.

In the case of the housing 3D models also display the relevance of the structure and the disposition in order to achieve bright flats always realized by using in an innovative way the traditional reinforced masonry.



Fig. 3: A never realized triumphal arch modeled and inserted in the existing city landscape

To fit these purposes the layer organization follows the systematic subdivision of independent 3D elements (e.g. floor, stairs, windows, walls, etc.): the 3D visualization allows a better understanding of the design concept and of the adopted technical solutions.

Under this perspective, the designs of Antonelli become an interpretation key to understand the process of the architecture in the city growth, also checking as the quality of the design can contribute to the urban image and the urban everyday life.

The case study of the district of Vanchiglia is especially useful to understand this aspect. The story of the strange building, popular in the city under the name of “fetta di polenta” (*slice of cornmeal mush*) because of its thin depth, is very effective by the video showing the origins of the district and the plot, as well as the visualized chronology by 3D of the changes achieving the final construction. The story is as hard to describe by words as easily grasping by the digital environment.

3D models have to be integrated in an informatics structure, which allows the direct link to the historical sources (drawings, pictures, iconography, etc.) and/or to previous published research about the same topic.

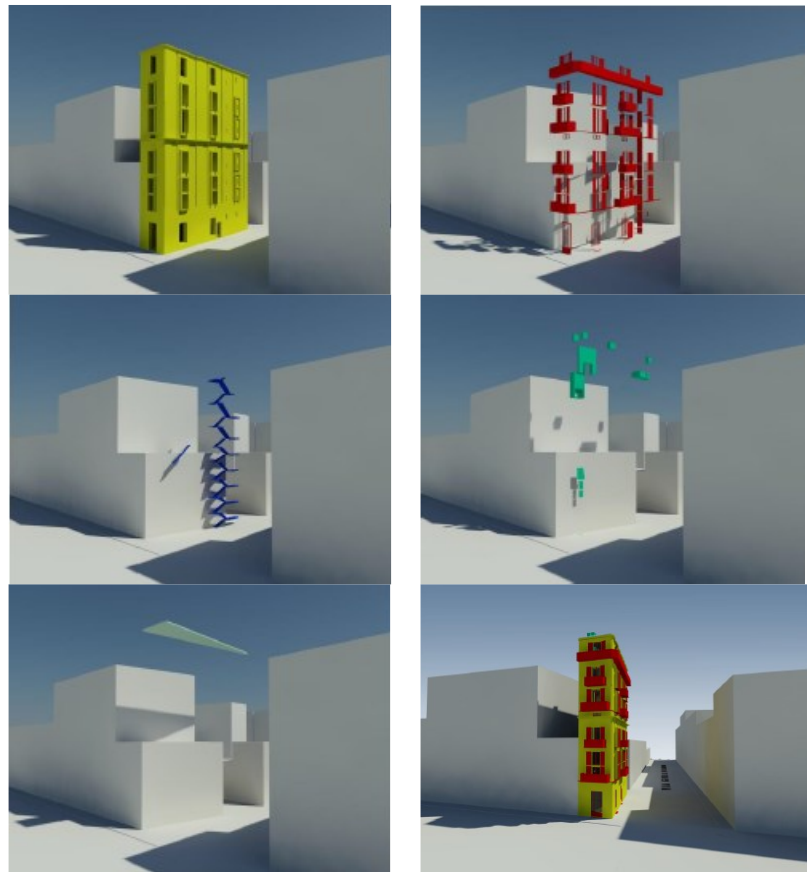


Fig. 4: The “fetta di polenta”. On the right the decomposition of the 3D model by considering different architectural components.

Because all the 3D models used in the historical research usually come from historical surveys or original design drawings. It is essential that each representation of 3D models (perspective or axonometric views, video, etc.) has to be documented in terms of metric system to allow the user to extract the metric information that are one of the historical data recorded on the used sources. Another important topic is the declaration of the level of detail of the produced 3D model to suggest the user the correct interpretation of the geometric models.

4. Turin in 20th century

The research on the 20th Cultural Heritage focuses on a street, via Roma, with its front rebuilt in the Thirties and it will discuss here mostly to mark the difference with the first study presented.

The difference is first in the identifying the historical urban landscape of the street as a Cultural Heritage by the definition of UNESCO.

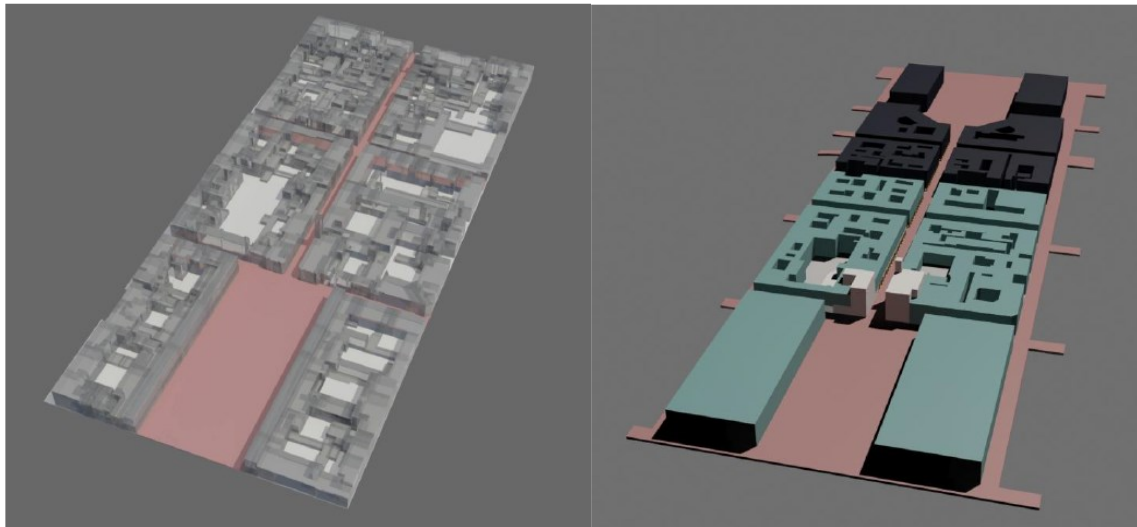


Fig. 5: The Via Roma (section from Porta Nuova up to Piazza San Carlo) in 1866 (on the left as extracted from the Rabbini's cadastral map) and in one of the designs realized for the reconstruction during the fascist period (on the right)

The digital approach is conceived in the aim of making more wider understandable this context, difficult to grasp because people is less familiar with modern architecture as an heritage as well as to read the urban open space.

Via Roma is still very important as central commercial area and it is a monumental way linking the main square with the monumental area of the Royal Palace and Palazzo Madama (both part of the UNESCO serial site of the Residencies of the Royal House of Savoy) with the 19th monumental building of the railway station through more monumental squares of different period.

The survey provide documentary evidence of a larger area around before the demolition. The change is visualized by 3D modeling the blocks before and after the demolition. The 3D models of the blocks related to the cartography make evidence of the structure of the street rebuilt with a larger area in order to rationalize the urban plan and its uses (Fig.5).

In addition the 3D modeling also aim to recreate other urban images demanding a more stressed idea of modernity in the context of the historical site.

These proposals created by the imagination of young architects were not successful. However, the large production of projects is essential to make understandable the relevance of the site originating many ideas and many discussions within the city now of the demolition (Fig.6).

The opposing visions also are as still visible in the two sectors as hardly understandable without an architectural guide. The digital environment also provides more information about the architects involved with these proposals.

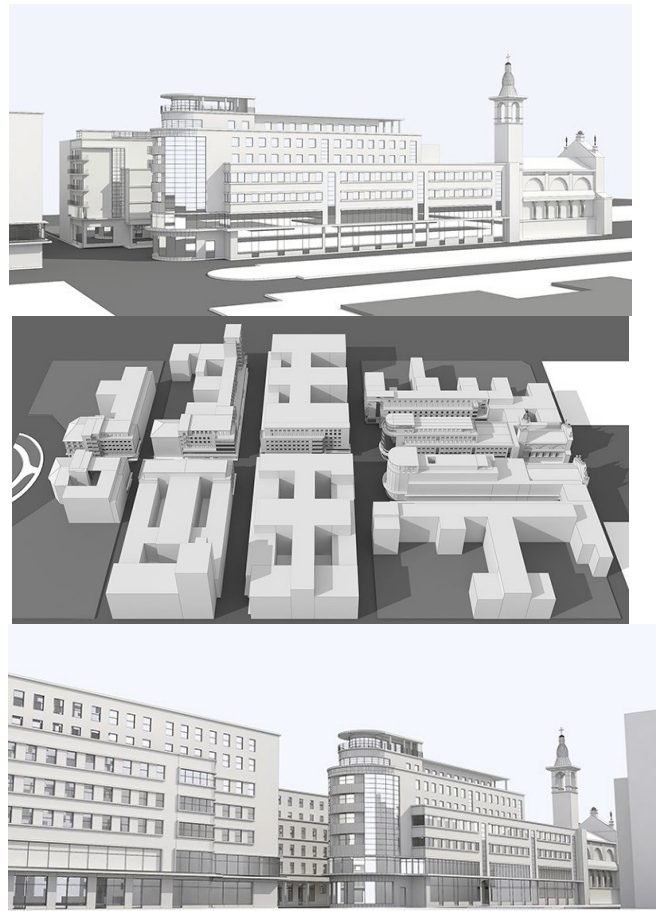
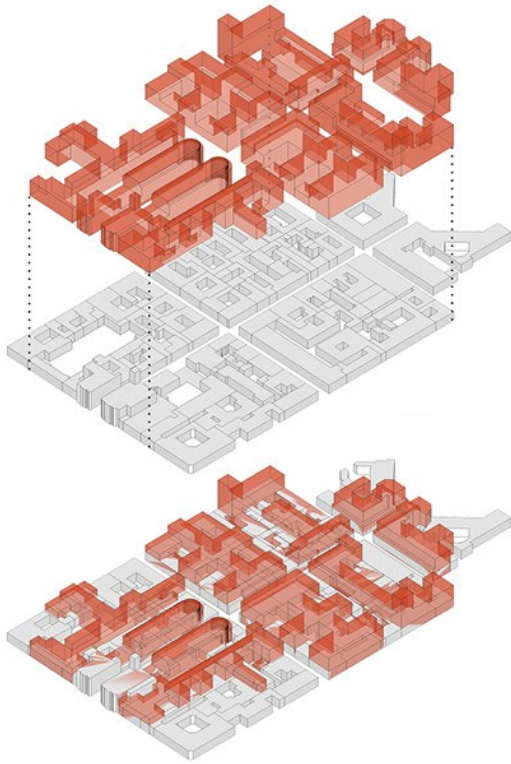


Fig. 6: 3D modeling of a portion of the design and of the buildings

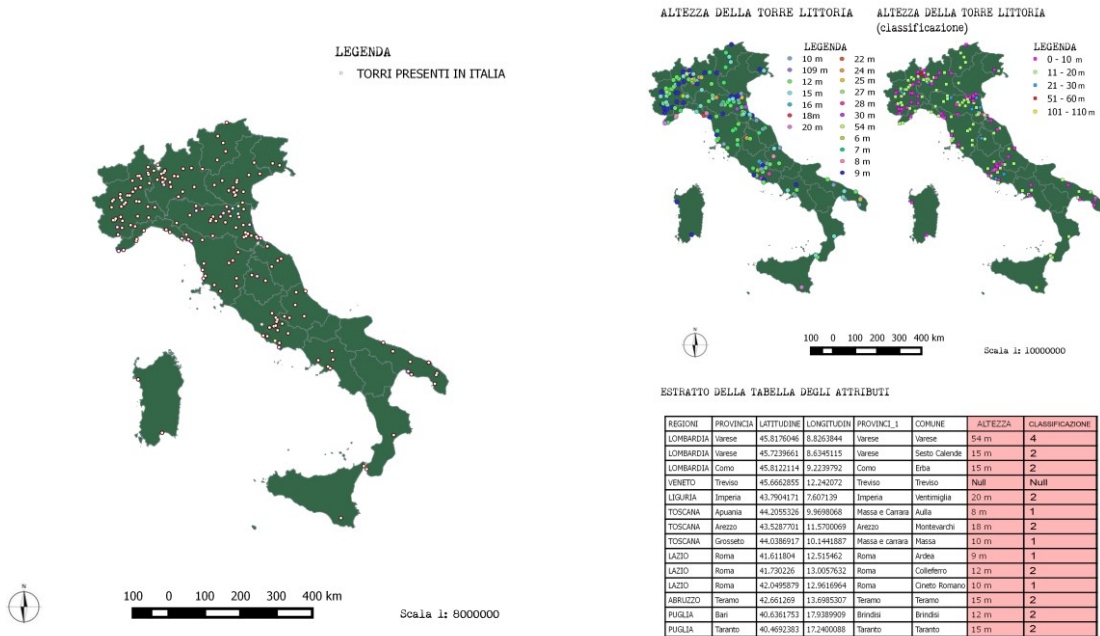


Fig. 7: Thematic maps generated on a GIS platform describing the diffusion of the "torri littoria" in Italy and their classification by considering the height

Moreover, peculiar urban stories are strongly related to the main history. As it is well known by the specialized studies, the modernization in this period was part of a larger government plan in Italy that is underlined by the tower, the *torre littoria*, in one of the blocks near the main square. This typology links to the fascist period with the range of the similar buildings realized in other sites in Italy and in the countries of a larger territory under the Italian control at that time. A GIS is devoted to collect and

spatialize this information by using the copious studied published on the subject (Fig. 7). The list of “torre littoria” buildings has been extracted from published cataloguing by considering different attributes (e.g. structural solutions, architectural models, physical dimensions, etc.) able to give to the users a complete view of this phenomenon and the today situation in all the Country

5. Conclusions

Despite the first studies presented above, this research aims to create digital environments for each block. They are conceived as databases collecting the documentation linkable also by the 3D models as sources. This approach also is asked by the complexity and quantity of records.

A careful design of the databases is the main step in digitization of historical research: the balanced mixing of different skills involved in the research is the starting point to select the correct set of feature types, the list of attributes and the connection with 3D models.

All the digital solutions pays attention to valorize the historical research results and are documented in such a way to allow a complete and effective use also for other possible researches. Open source format (e.g. shapefile for GIS layers and 3Dpdf for 3D models) are used to reach this last goal.

In the first case (Turin in the 19th century) the punctual buildings are used as a key telling about the city, in the second case (Turin in the 20th century) the urban area is the key to go through single stories of blocks, plots or uses.

In both examples, the result obtained has been to allow a wider access the rich heritage in the archives, museums and libraries. The aim has been to share the outcomes of the research and to produce a visualization of the data interpretations in order to achieve digital tools effective to grasp the Cultural Heritage.

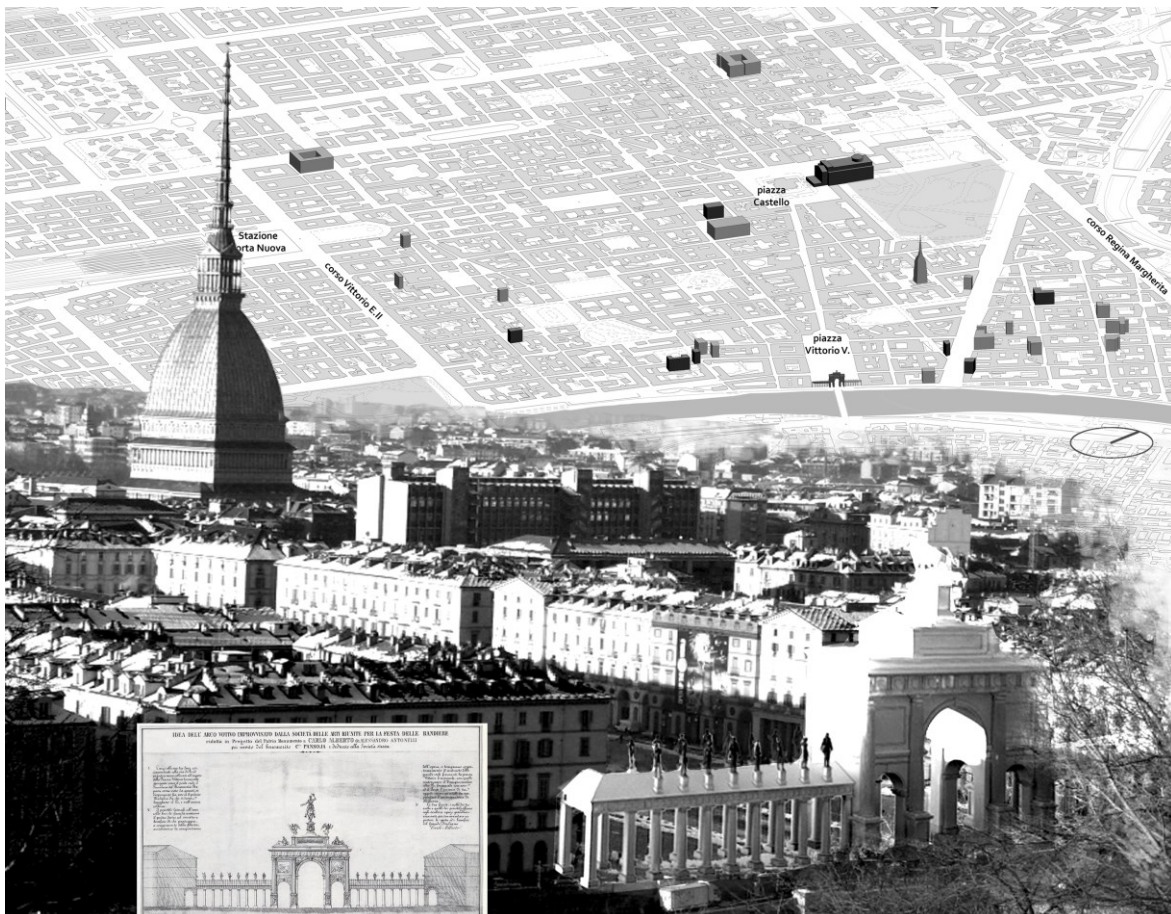


Fig.8: The digital tools linking the data visualization to the drawings in the archives

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