Architecture and representation: digital *surveying* of Pavilion 19 of the former Slaughterhouse (Ex Mattatoio) of Rome

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***Abstract*— The survey discussed here concerns a critical review, through the use of digital technology, of the original design by Gioacchino Ersoch of Pavilion 19 of the former Slaughterhouse of Rome, which was constructed between 1888 and 1891. The intended use of the building required its sub-division into spaces that were subject to strict health regulations. Interventions carried out post-construction, during the course of the 20th century, modified both the formal appearance and the spatial configuration of the complex. The development of a digital model – through the processing of the design drawings and working documents pertaining to the original construction – has made it possible to revisit the original spatial arrangement, verifying the architectural language and construction techniques implemented. The building in question is characterised by the use of iron, brick and plaster. By conducting a *digital* survey on a work designed by a specific, *named* architect, it has been possible to reconstruct the creative path (the concept) of the architecture, which was associated with a particular historical period – the late 19th-century. The complex's invisible "memory" comes to light through the digital design/model: the investigation was geared towards finding out what cannot be conserved – because it is no longer extant – but which could, nevertheless, offer stimuli for future intervention strategies. The survey was carried out on three parallel levels – architectural, structural and decorative – and has enabled charts of the elements to be put together that allow for recognition of what has been lost and what, in contrast, remains, both in the specific pavilion in question and across the entire complex, since the complex was subject to a great deal of replication and standardisation. Currently, parts of the pavilions of the former slaughterhouse are being used by Roma Tre University.**

Keywords—representation; analysis; 3D modeling; documentation; visualization; virtual

I. INTRODUCTION

The digital reconstruction of the original design of Pavilion 19 (1888-1891) forms part of a work-in-progress on the former Slaughterhouse of Rome and, more widely, on industrial archaeology. The general theme is based on experimenting with the use of information technology in relation to architecture; in other words, on gleaning an understanding of the possible applications for the representation of industrial archaeology for the purposes of conserving and converting architecture to new uses. The task undertaken during the phase being presented at this convention was to reveal details that are no longer visible but that are required in order to bring back to light the "Ersochian logic" of the design of the industrial complex and the principles adhered to for its insertion within the Roman urban context. With a view to studying the strategies for enhancement, the purpose of the research is to discover the temporary and permanent transformations undergone by the former Slaughterhouse, which now – in a number of its pavilions – houses a part of Roma Tre University, in order to flag up its use as an example of a "cultural workshop" that is very much integrated within the city.

The digital model, then, constitutes a form of analytical historical documentation, since its development came about through the processing and interpretation of the original design drawings and of the Report on the Works drafted by Ersoch himself upon completion. This phase was followed by a comparison of the model with the data produced by the surveys carried out over time using the total station and and with the point cloud acquired in May 2013, in order to get a handle on the continuities/discontinuities between various configurations of time, space and matter. The intention was to understand the logic (including the graphical logic) of the original concept and of the restoration interventions, uncovering the connections between the building in question and the IT methodologies to be developed. Moreover, since this building dates from the late 19th century, recourse was made during the development of the model to the manuals of the time, comparing the construction methods and technologies represented therein with those proposed in the design and those identified during the survey. The instruments used for the development of the geometric model were applications for 3D modelling and rendering, along with CAAD software for the two-dimensional data management. The current phase in the analysis has highlighted a number of families of elements and "typical sections" to be developed, in the near future, with BIM technology (Building Information Modeling) in order to make use of invariants for the control of future transformations.

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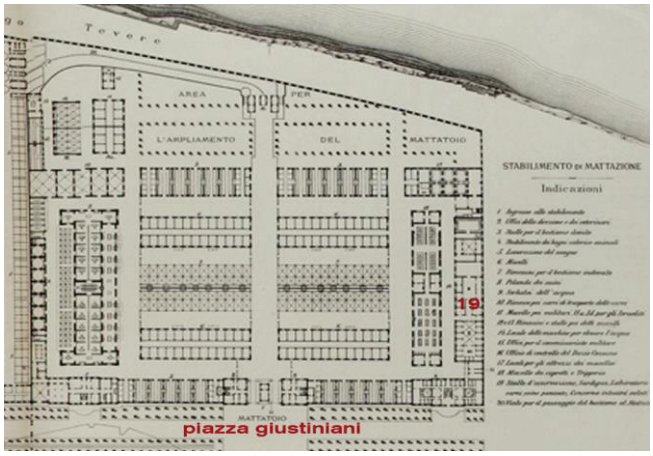


Fig. 1. Original design of Slaughterhouse and Cattle Market in Rome, 1888-1891. The main entrance of Slaughterhouse is on Piazza Giustiniani.

II. THE DIGITAL RECONSTRUCTION OF THE "MEMORY": METHODS AND PROCEDURES IN RELATION TO THE ARCHITECTURE IN QUESTION

In the description of the original design for Pavilion 19, which was intended to serve as *Inspection sheds for sick livestock, Distribution of infected meat, Processing of pork slightly infected with tapeworm, Conservation of salt-cured intestines, Pigsty*, Gioacchino Ersoch states as follows: "These services are located in the building sited at the edge of the Slaughterhouse, in the extension on Via Aldo Manuzio…" [1]. It is worth stressing that the siting "at the edge of the Slaughterhouse" was considered as such, with respect to the location of the Slaughterhouse itself and the Cattle Market, on the basis of an orthogonal matrix, running from the main entrance on Piazza Giustiniani (Fig.1). The current multi-functional use of the complex, which sees it entrusted to various organisations using a number of different entrances, has rendered Pavilion 19 a main hub for Roma Tre University, since it creates, with its parallel structure and Building No. 4 at the front, a communal space of utilisation/aggregation for users.

Originally, the Pavilion was designed to have a longitudinal brick section, split into spaces with different functions and divided by transversal brick walls, with courtyards featuring iron pillars, pitched and hipped roofs, along with the use of Polonceau trusses, iron beams and Marseille tiles. In 1932, a series of works completely overhauled the internal layout. The alternation of open and closed spaces, which ran in a single direction, was lost with the changes made to the design of the roofing structures. The ongoing research operation has been carried out in several phases: the first phase saw the processing of the architect's original drawings and the report submitted upon completion; the second phase involved the two-dimensional digital redesign of the plan, section and elevations. The redesign triggered a number of considerations that proved useful in recognising the typical framework that inspired the layout. The subsequent phase saw the surveying of the elements found in other pavilions but now missing from Pavilion 19.

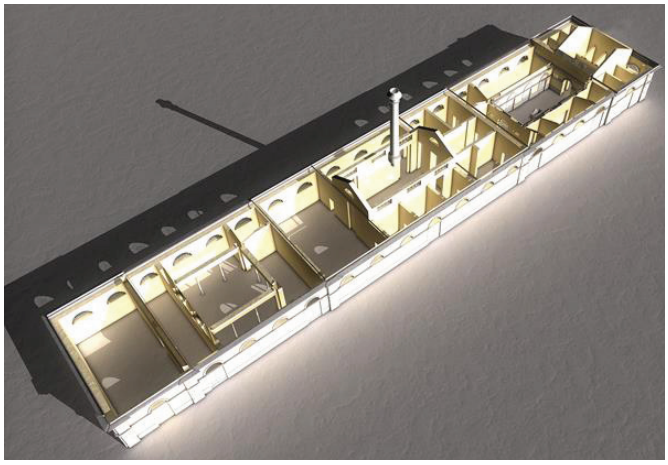
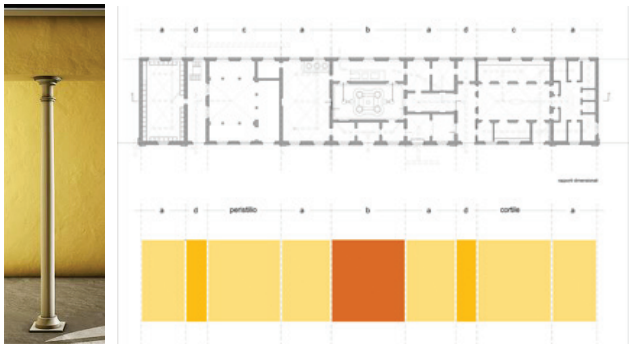


Fig. 2. A view of 3D modeling of the original design of Pavilion 19

The development of the 3D model involved the modelling of the components and the subsequent assembly of a complete model (Fig.2). Once complete, work began on producing the charts of the elements in the orthogonal and 3D views for an initial architectural, structural and decorative cataloguing. The study should proceed on three different levels: architectural, structural and decorative, with a view to identifying the material components, the technological solutions and the language adopted. We produced a higher number of cross-sections than Ersoch had done, because we felt it was necessary to verify certain elements in the construction that were not covered in the design drawings but that were essential to the construction of the model. In addition, since a number of discrepancies emerged from the design drawings, we deemed it appropriate to confirm the hypotheses we had arrived at through the surveying of similar elements. During the construction of the 3D model, which was carried out in several parts, we decided to link the methods of digital construction of the elements to the methods of constructing and assembling the real elements of the construction, as occurred for example in relation to the single-piece cast-iron columns, for which we used the profile generated by the two-dimensional drawings for the creation of the revolved surface (Fig.3). In contrast, for the Polonceau trusses we utilised the model generated by the Expert System deployed in a recent survey campaign (2005) by Roma Tre University's Graphical Representation Laboratory following a painstaking analysis of the data contained in the design [4]. The identification of the formal genesis of the elements was utilised for the three-dimensional construction operations. The discrepancies that emerged in the design drawings essentially concern the building on the eastern front: the section/elevation design of the roofs. For this reason, we developed the roof-level plan – not found among Ersoch's drawings – which has allowed us to make evident the series of spaces and the alternation of the types of roof along a preferential direction, and to verify – through the shadows revealed by an aerial photograph of 1926 – the actual profile of the section and of the elevation in the spaces given over to the conducting of experiments on animals. To resolve a number of doubts on the interpretation of the design, we were greatly assisted by the original delineation of the shadows, which served not merely as an aesthetic expedient



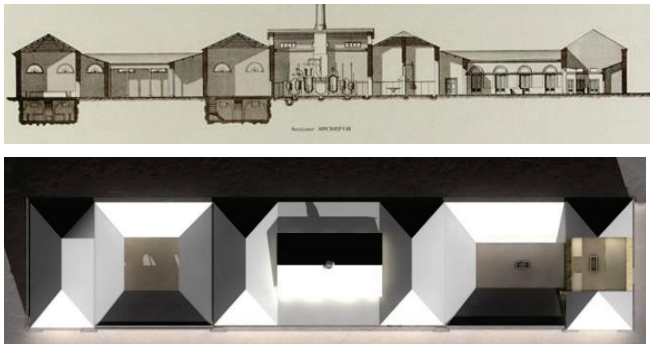
Figg. 3-4. The iron colums and distribution pattern of Pavilion 19 with the reference to *domus*

but also as a means to monitor the quantity of light/air in the internal spaces and the dimensions of those spaces. We wanted to use within the digital model a shading algorithm for the same ends as those of the architect. The redesigning of the original plans, elevations and sections proved extremely useful in the effort to recognise typological references leading back to the *domus romana* and the *horrea* (warehouses) that had previously existed in the area (Fig.4). The model of the original design is a fact-finding model that covers the spatial, formal and geometric aspects, and it serves to show us today what the initial intentions were and the capacity that the building has shown in coping with the man-made transformations imposed upon it over time (Figg.5-6). The research also dealt with the insertion of the Pavilion in a model composed of cut-outs of the volumes of the general complex of the Slaughterhouse and the Cattle Market (Fig.7). Now the restored "memory" is a historical document, an opportunity for reflection on possible experiments to be carried out on the spatial aggregations, since it compiles information that can be taken into consideration for the transformation of a future space.

III. LINE OF DEVELOPMENT OPENED UP BY THE COMPARISON OF THE DIGITAL RECONSTRUCTION AND THE SURVEY OF THE EXISTING STRUCTURES

There are currently various research paths. The first, in place, focuses on cataloguing in greater detail the elements of the construction, and is being carried out through the identification of elements that can be repeated in series and produced by specific technologies. This approach is linked with the production of charts in order to collect families of components to be managed in the next future with the BIM technology. Indeed, the trusses, the roof types and the brickwork sections are also found in the other buildings of the complex and it is then necessary to address the management of their "lifetimes". The second path concerns the analysis of the material and immaterial elements, with the aim of generating spatial aggregations within the complex and with the surrounding site.

For this reason, the study concerns the existing building. With respect to the current construction of the Pavilion, we considered the data from the survey campaign carried out in the year 2000 (with total station) consisting of



Figg. 5-6. Original Design of Longitudinal Section and the roof-level plan, view of 3D Modelling

plans, sections and elevations (Fig.8). This two-dimensional information was mounted onto a cut-out scaled as per the survey. The area of the former Slaughterhouse, where Pavilion 19 (the current No. 7, used as classrooms) is located, has undergone 3D laser scanning as part of this research project. The instrument used was the HDS 6100 of Leica Geosystems with external camera, using the Cyclone software. We made use of three external stations, of which two are aligned at the corners of the Pavillion 19. A fourth station was placed inside. The final point cloud has made it possible to generate some inputs which were relevant to the aforementioned theme. The number of points of each cloud was 22 million and was acquired for a equirectangular photo (1 gigapixel) for each station. The current point cloud can be used for a neutral, multi-faceted reading of the existing structure (Fig.9). Our aims were to use the laser scans in order to acquire a large quantity of information – contained in the point clouds – over and above the habitual level of *predictability* shared by the other surveying methods. Therefore, the management of the *unpredicted data* is channelled through an interdisciplinary prism, where it can provide stimulus to understand/decipher the various environmental and architecture invariants – present but not perceptible – with a view at broadening the range of design choices for future interventions related to the current state of utilisation. The analysis of the point cloud alone – and not of its management and transformation into a polygonal model – in a situation in which you already have access to data generated by two survey campaigns (2000 and 2005),

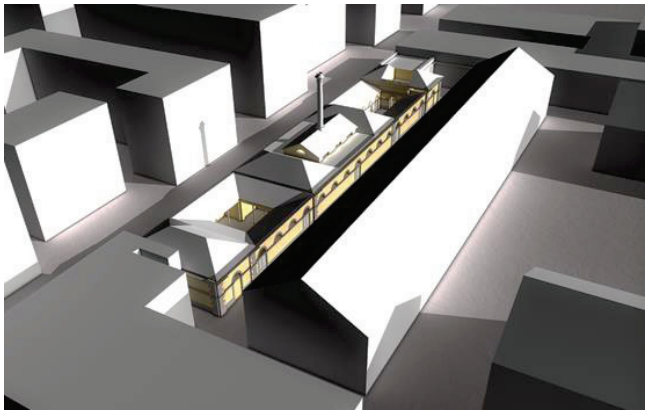


Fig. 7. Insertion of 3D modeling in the general urban complex

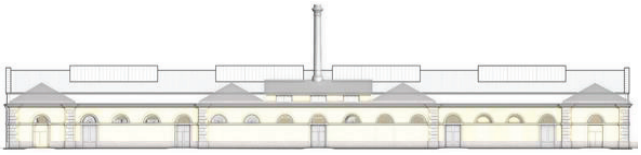
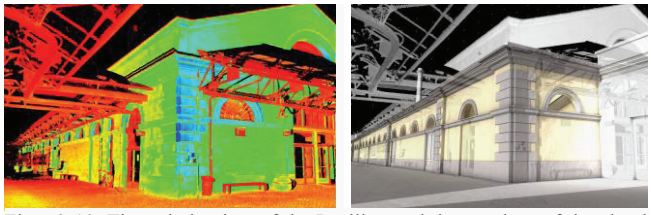


Fig. 8. Overlays of data of digital reconstruction with the data of survey

is intended to generate *an inventory of knowledge*, affording access to ideas and arguments, real or plausible, that are relevant to the purposes of the project. As of today, the study is being developed in order to discretize, also with future acquisition, parallelepiped with pitched and hipped roofs, identifying the repetition of elements such as brickwork, cornices, fanlights, gables, ashlar panels, iron columns. One of the aspects dealt with is the morphology of the space, the voids and the material levels, interpreted through dimensional and chromatic data contained in the cloud. The points of the cloud show different colors depending from the presence of different materials (iron, brick, plaster and travertine). At the same time the formal recognition of the elements identified the use of a linguistic repertoire that harmonizes the different materials. The architectural elements that define the configuration – and define its visible sections, the relations between its overhangs, the material force of its angles, the relative shaded areas and the directional flows of users – are independent from a two-dimensional representation or from polygonal modelling, but already exist in the three-dimensional reality of the cloud. The reading of the various relations will then be transformed into specific models thanks to the subsequent processing of the data acquired (Fig.10). This applied research was possible thanks to the "life" of this pavilion, which underwent major building works in 1932 that transformed both the internal distribution of the space and the structure itself, leaving the perimeter walls (which remained unaltered in their form and architectural language aside from the addition of an attic) to serve purely as the "container" of the space within. The study/analysis of the third path is already under way, and focuses on the deepening of our understanding of the two Pavilions in the complex, which have been subject to radical transformations over the time; the "memory" of these spaces, reinterpreted using digital instruments, can restore value to what is now in a state of complete neglect or has been earmarked for a new use. The aim is to reconstruct the analytical historical documentation of the building that housed the Refrigerators and the Stables for tamed cattle. The former was not covered by Ersoch's original design, dating since 1911, and features a reinforced concrete structure using an architectural language that recalls that of the 19th-century buildings. The Stables, which did form part of Ersoch's original design and are characterised by sheds with cast-iron pillars, underwent a major transformation through the insertion of shackle lines between 1923 and 1932 to update the slaughtering system. In conclusion, the buildings that compose the current complex are all repositories of memory, of the fabric of which they are a part, and of the city. The study presented



Figg. 9-10. The colud points of the Pavilion and the overlays of the cloud points and 3D reconstruction of the design .

at this conference is one of the ways to use and integrate digital representation in relation to the built heritage.

The models presented were created by architect Andrea Benedetto, post-graduate research fellow.

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