Ubaldo Castagnoli:
on the Graphic and Historical Traces
of an Exponent of Gruppo 7

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Abstract

In 1926, a group of seven friends who studied at the Regio Istituto tecnico superiore of Milan –made up of Ubaldo Castagnoli, Luigi Figini, Gino Pollini, Guido Frette, Sebastiano Larco, Carlo Enrico Rava and Giuseppe Terragni– decided to found Gruppo 7. Between 1926 and 1927, the seven young architects published some articles in the journal Rassegna Italiana *that are still considered today as one of the founding moments of the new Italian architecture. Ubaldo Castagnoli left the group almost immediately, being replaced by Adalberto Libera and, for this reason, his name disappears from the history of architecture books. The career of this professional developed within one of the most important companies in the country, STIPEL, the Piedmontese and Lombard interregional telephone company (which in 1964 was incorporated into the SIP), with the role of Central Director at the disposal of the General Management of real estate affairs. He also had a long professional relationship with Luigi Einaudi, before and while he was President of the Republic. The work presented below aims to continue the research recently inaugurated on this figure, that is still not adequately investigated, in order to deepen the role of the cultural debate of those years on his vast professional activity, working with the methods and techniques of the disciplines of representation.*

Keywords: Gruppo 7, BIM, STIPEL, archives, graphic analysis.

Introduction

The paper aims to investigate, through the tools and techniques of representation, the culture of the project of Ubaldo Castagnoli, architect of Gruppo 7, continuing the work recently inaugurated by the research group. From a first list of his works, still incomplete, two buildings were selected and some critical readings were conducted initially on his graphic language [Velo, Castagnoli, Incerti 2020], in relation to the course of higher studies and the debate then in place [Buratti Mazzotta 2013; Moretti n.d.; Selvafolta 2008, 2012]. Reflections were also proposed on the use of form [Velo, Castagnoli, Incerti 2020] and on original perceptual aspects of some spaces that today have been strongly transformed. At a later stage, the three-dimensional digital reconstruction was used, according to a method that is now widely consolidated in the scientific disciplinary sector, in its value both as a study tool and as an opportunity to enhance and disseminate the theme of the architectural project not built or lost due to subsequent events [Incerti, Mei, Castagnoli 2021]. The present contribution aims to analyze two buildings, Centrale Telefonica di Città Studi in Milan and the Palazzo dei Telefoni in Turin, systematizing archive drawings, documents, surveys of the facades and techniques of two- and three-dimensional graphic analysis (both in BIM environment and with manual modeling of NURBS surfaces).

Ubaldo Castagnoli and Gruppo 7

The architect-engineer Ubaldo Castagnoli (Rome 1902 - Turin 1982) graduated in 1925 from the Regio Istituto Tecnico Superiore of Milan. In this environment he met the young colleagues, who were tutored and influenced by Piero Portaluppi (then he was assistant to the chair of Architecture) and in 1926 they decided to found Gruppo 7, the first group of modern Italian architects, composed precisely by Ubaldo Castagnoli, Luigi Figini, Gino Pollini, Guido Frette, Sebastiano Larco, Carlo Enrico Rava, Giuseppe Terragni [Belli 1935; Betta1927; Cartasegna, Santi 2017; Pacifiers, Bricklayer 2010]. The seven colleagues sign with the name Gruppo 7 the four famous articles that appeared a few months later in the *Rassegna Italiana* magazine between December 1926 and May 1927: these articles and the lively debate that followed are still considered today one of the founding moments for the new Italian architecture. As known, Castagnoli's membership to the group was short: he was immediately replaced by Adalberto Libera and, for this reason, his figure almost immediately disappears from the pages of history of architecture books.

In addition to his participation in the 4th Triennale di Monza (1930), the 2nd Exhibition of Rational Architecture (1931) and the Permanente in Milan (1931), the first works produced by our research-group have pointed out some collaborations with well-known figures of the epoch, including Guido Frette (1929-1935), Piero Bottoni (1930) and Antonio Cassi Ramelli (1933) [Buffa, Cassi Ramelli 1934; Caneva, Griffini 1930; Castagnoli, Frette 1934; Incerti 2016; Istituto per le case popolari Milano 1933; Rassegna di Architettura 1931].

In 1935 Castagnoli was hired by the STIPEL Telephone Company for which he worked as an engineer of telephone exchanges for the Piedmont and Lombardy area until 1962 when, due to some health problems, he resigned while continuing to work for the company as a freelancer. The intense development activity of the telecommunications sector (especially after the war) in which Castagnoli worked, as well as the confidentiality required by his important role, certainly did not facilitate his notoriety which, however, had to be remarkable, given that, in 1947, he started to work for Luigi Einaudi, with whom he had a long and fruitful relationship that lasted even while Einaudi was President of the Italian Republic.
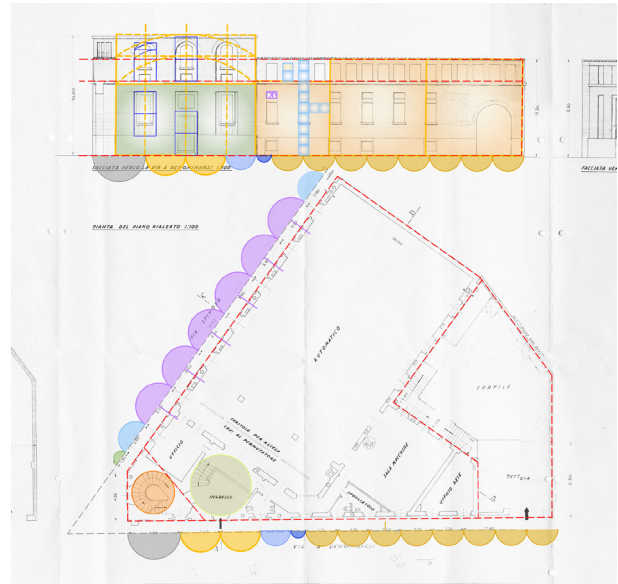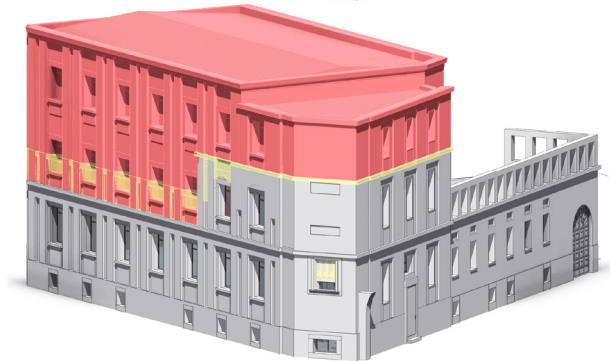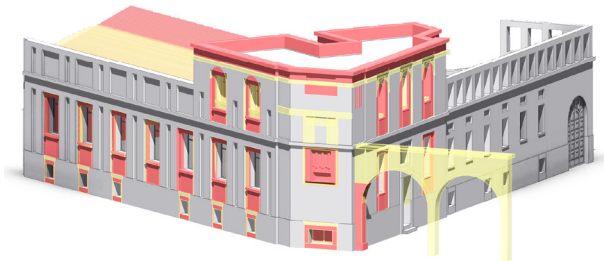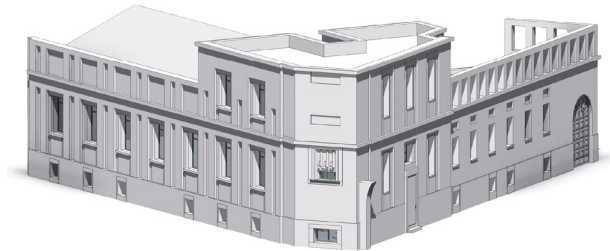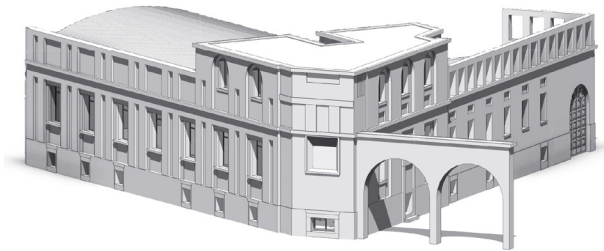

Fig. 1. Centrale telefonica di Città Studi, analisi grafica del piano rialzato e del prospetto su via Villani (1939), (elaborazione grafica degli autori).

The first project for the Centrale Telefonica di Città Studi

The project for the Centrale Telefonica di Città Studi started in 1938, in a historical period of impressive development of the telecommunications network and in an area of urban expansion which had long been destined to become a new university area. Twenty-five years earlier, in 1913, Augusto Brusconi and Gaetano Moretti, professors of the R. Politecnico di Milano of Milan, had carried out a general project of the university complex consisting of nine buildings connected to each other [Ricci 2008]. The construction, interrupted by the great war, ended in 1927, the year in which the inauguration took place. The first telephone exchange of the company, located in the main building of the University, quickly became insufficient for the growing needs. The impossibility of building extensions led the Company to identify a new plot in the area north of Piazza Leonardo where, in 1919, the Gran Sasso Garden Village was built to respond to public housing shortage.

The irregular shape of the plot is the result of a series of changes to the Town Plan and consequent negotia-

tions, documented by some planimetric hypotheses and sketches preserved in the folder relating to the project (Archivio Storico TIM, Subfondo "DCT – Direzione Centrale Tecnica", Serie "SE - Servizio Edile, faldone 7/2). The building overlooks the pre-existing Via Spinoza (to the south-west) for about 31 meters, Piazza Leonardo (to the south) for just over 4 meters, and a new road that will be called Via Villani (to the East) for about 34 meters. On the opposite side of the latter street, the construction of a parish complex was planned. Its project was initially conferred to Giovanni Muzio (1893-1982) but was then carried out in 1955, with more sober forms, by Giuseppe Chinigher (1921-2012).

In 1939 the expropriations and demolitions of the residential buildings of the Garden Village were carried out; the construction works began in 1940 and ended in 1943 (therefore in the middle of the war) as evidenced by the contracts with the construction company. The morphology of the building, which can be divided into three blocks, arises from the need to fit into an irregular polygonal plot: the two-level volume on via Spinoza (1) occupied by the
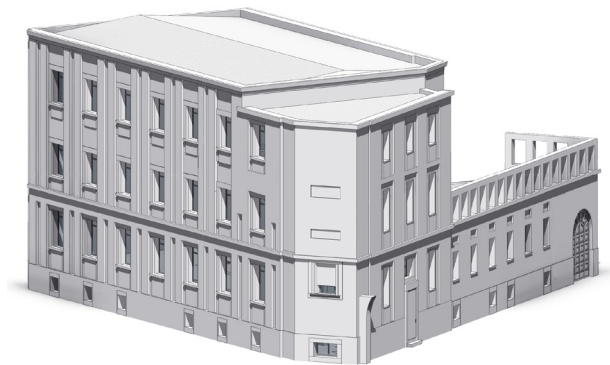
Fig. 2. Centrale telefonica di Città Studi, viste assonometriche del primo progetto del 1939 e dello stato comparativo tra il primo progetto del 1939 e la realizzazione completata nel 1943 (elaborazione grafica degli autori).

Fig. 3. Centrale telefonica di Città Studi, viste assonometriche della realizzazione del 1943 e dello stato comparativo tra la realizzazione del 1943 e la sopraelevazione del 1962 (elaborazione grafica degli autori).

Fig. 4. Centrale telefonica di Città Studi, vista assonometrica con la sopraelevazione del 1962 (elaborazione grafica degli autori).

actual telephone exchange; the one on via Villani (2), again on two levels, dedicated to the rooms for heating, offices and the engine rooms; and finally the one on the corner of Piazza Leonardo (3), on three levels, occupied by staircases, offices and the caretaker's apartment. This planimetric partitioning can be also recognized from the outside, thanks to the composition of the volumes: volumes 1 and 2 are made up by basement and ground floor, while volume 3 consists of basement, ground floor and first floor. From the project drawings of the young engineer-architect Castagnoli it is possible to deduce his attention for technological innovations and for the debate on the theme of the architectural project which, in the development of the architectural process, necessarily find continuous interactions between them.

The structure of the building was planned in brick masonry, unreinforced concrete, reinforced bricks and, only partially, in reinforced concrete ((Archivio Storico TIM, Subfondo "DCT – Direzione Centrale Tecnica", Serie "SE – Servizio Edile, faldone 7/2) see the application to the

Fig. 5. Centrale telefonica di Città Studi, abaco delle famiglie parametriche delle finestre del modello BIM (elaborazione grafica degli autori).
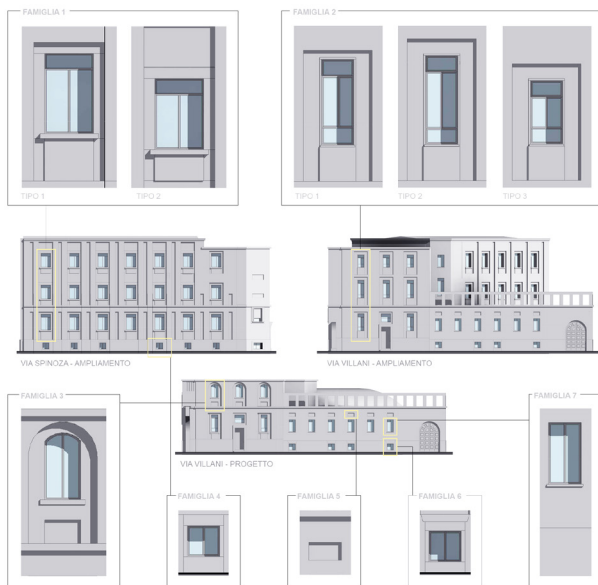
Ministry cited in correspondence dated November 16th, 1939). The roof of the large room called 'automatico', 14 m wide and about 25 m long, is indicated in section with a lowered arch typical of the Volta SAP. Presented for the first time at the Milan trade fair in 1938 with the famous large arched structure, the system had been patented in 1936 and was produced by the Fornaci Fratelli Rizzi Donelli Breviglieri & C. of Piacenza. This is the same technology that Giuseppe Pagano decided to use in 1939 in the extension project of the building Nuova Pettinature Riunite in Biella (in collaboration with engineer Predaval), and that few years later, in 1943, was also used by Piero Bottoni for the roof of the Olivetti Shyntesis factory in Apuania. Two examples referable to industrial architecture, an area in which this technology was actually widely used [Paolini, Pugnaletto 2017].

The graphic analysis conducted on the original drawings can help us reveal the architect's thinking and his cultural and design references, explicit or implicit. Observing the elevations gives us the perception of a regularity punctuated by the openings and setbacks of planes that materialize, especially on Via Spinoza, a system of beams-pillars, which is useful for internally incorporating ducts for the technical systems. The windows are highlighted by large stone frames and high windowsills. Above, the theme of the loggia with an architrave is treated differently on the south-west side (closed) than on the east side (open). It is still possible to note how some circular shapes characterize the plan of the entrance and the staircase, the openings on the first floor, the two access arches to the current Via Villani (never completed even if set up, as can be seen from the fragment still existing today) and the entrance to the court. Overall, as noted in a previous contribution [Velo, Castagnoli, Incerti 2020], these are forms that are closer to the Milanese twentieth century language than to the international rationalism.

The reading of the compositional module, in plan and elevation (fig. 1), highlights a certain complexity, which finds its own development logic, when we refer to the three volumes previously identified. The module of 3.90 m. of the opening's axis on via Spinoza, is in fact different from that used on via Villani or on the corner volume. It is clear that all the modules are based on the distance between the voids and not on the solids/voids ratio which. In the execution phase, this distance will be sized and proportioned to the dimension of the brick, the true module of this architecture (24-24.5 cm; 11.5-12 cm; 6.5 cm with

mortar thicknesses of about 1 cm). Finally, figure 1 shows the use of some notable proportions (golden ratio, √2, √3, 1: 2) which denote the research, not necessarily rational or conscious, of proportional relationships between the parts.

As will be further explained below, the project examined so far differs from what was actually built. In fact, all the arches disappeared except those of the access to the courtyard: a change of language that had certainly have repercussions in terms of simplification in the construction and, therefore, in terms of costs.

The project drawings of the *Templum Reginae Pacis Augustae* in Milan - Città Studi, elaborated in 1939 and preserved in the Archivio Muzio [Irace 1994, pp. 211, 212] help us to reconstruct the meaning of some of Castagnoli's design choices. In those years Muzio was already a very successful professional, author of numerous civil and sacred architectures including Università Cattolica del Sacro Cuore and its chapel (1929-1949), S. Maria Annunciata in Chiesa Rossa church (1932), Sant'Ambrogio and Sant'Antonio church and convent in Cremona (1936-1939), Sant'Angelo church and Angelicum cultural center in Milan (1939-1947), whose language marks a turning point in the architect's poetic and professional career [Irace 1994, pp. 203-230].

The analysis of Muzio's drawings for the church of Città Studi shows a series of formal and material similarities with the project for the Castagnoli telephone exchange. The new *Templum*, of imposing dimensions, presents an organization of the surfaces similar to the other contemporary Milanese works of its author: horizontal and vertical bands whose measurements are given by the module of the brick, as well as backward or protruding squares or rectangles and round arches. The roofs of the large hall and the accessory building on the north side are curved, therefore large SAP vaults were likely planned. In the drawings and in the model of the project there are also the two arches that frame the beginning of the new via Villani, the same ones that appear in the project of Castagnoli telephone exchange and that are sketched in pencil, in plan, in elevation and on the plan in scale 1: 500 about the land subdivision in plots. In this last drawing, preserved in the project folder, also the articulated perimeter of the church of Muzio (80×69.38 m) appears. The direct confrontation between the two architects is, among other things, testified also by a memo for the STIEPEL General Manager, dated April 1939.

Fig. 6. Centrale telefonica di Città Studi, sopra: vista dell'ingresso dalla porta di accesso, sotto: vista della scala principale (elaborazione grafica degli autori).

Fig. 7. Centrale telefonica di Città Studi, vista degli esterni da Piazza Leonardo da Vinci, al momento della prima realizzazione completata nel 1943 (elaborazione grafica degli autori).
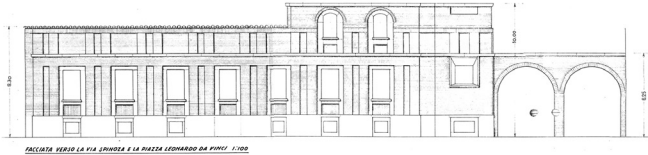
Fig. 8. Centrale telefonica di Città Studi, prospetto su via Spinoza. Sopra: primo progetto del 1939; sotto: ortofoto elaborata con fotogrammetria digitale (elaborazione grafica degli autori).
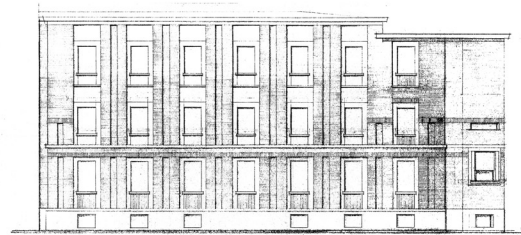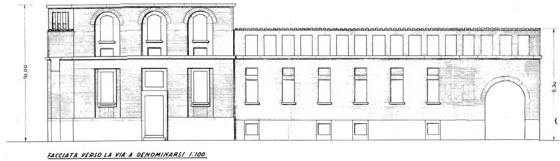
Fig. 9. Centrale telefonica di Città Studi, prospetto su via Spinoza. Sopra: progetto della sopraelevazione del 1962; sotto: sovrapposizione tra ortofoto e progetto del 1962 (elaborazione grafica degli autori).

According to these documentary evidence, it is clear that the Città Studi project was born with the intention of harmonizing it with the neighboring building, adapting dimensions, materials and proportions, with a measured and respectful attitude that we will see also in the Turin theme illustrated at the end.

The later projects for the Building in Città Studi: from archive drawings to 4D BIM visualization

Castagnoli worked again on the telephone exchange to design a raising project –which gave the building its current shape– in 1962, the same year in which he resigned from STIPEL, due to health reasons. This second project is therefore part of that series of works that the architect carried out for the telephone company as a freelancer after his resignation, as evidenced by the fact that the related documents are kept in the family's private archive.

This temporal information relating to the phases of the building (first project in 1939, construction in 1943, raising project in 1962) were integrated with the three-dimensional geometric ones within the digital model, in a BIM environment with the software Revit, in compliance with the standard UNI11337-1: 2017 which describes the fourth dimension of information models as the 'simulation of the building or its elements as a function of time'. Within the BIM environment, in fact, the models can be made up of 'phases', each representing a distinct period of the life of the project and in particular in H-BIM projects these phases are generally used to describe the evolution of the building and its changes over time [Brumana et al. 2013, Calcerano et al. 2017].

The BIM modeling was carried out on the basis of archival drawings, thus following a procedure of which the examples in the literature are relatively numerous [Bertola 2020], while there are many case studies of BIM models based on indirect surveys integrated with archival documentation (see in this regard the experiences on buildings da-

Fig. 10. Centrale telefonica di Città Studi, prospetto su via Villani. Sopra: primo progetto del 1939; sotto: ortofoto elaborata con fotogrammetria digitale (elaborazione grafica degli autori).
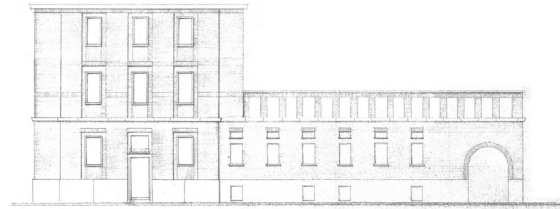
Fig. 11. Centrale telefonica di Città Studi, prospetto su via Villani. Sopra: progetto della sopraelevazione del 1962; sotto: sovrapposizione tra ortofoto e progetto del 1962 (elaborazione grafica degli autori).

maged by recent earthquakes). In particular, for the graphic reconstruction of the phases, the differences between the archive documents were analysed: the parts of the architecture, modified over the course of about 25 years, were progressively documented in the model, without altering the main dimensions of the composition system. Thanks to this temporal structuring of the model, it was possible to create, in addition to the three-dimensional views corresponding to the three phases, also those that highlight the differences between them, showing the removed elements in yellow and those added in red (figs. 2-4). It is therefore noted how, already in the passage from the first project of 1939 to its initial construction completed in 1943, some changes were made, in addition to the already mentioned disappearance of the arches: the SAP vault was replaced by a double pitched roof, the body corner was raised and some compositional and decorative elements of the openings were simplified.

With the raising project of 1962, two floors were added to the first volume on via Spinoza, while on the corner volume, which already had an extra floor, only one was added, with a more limited height, so that this corner volume is lower than the rear one. While still maintaining the same composition scheme of the facades, this intervention completely transforms the general proportions of the building. In fact, previously the facility had a mainly horizontal extension with a plan development much more consistent than the one in elevation, having only one floor above ground, except for the limited two-storey corner portion. Following the raising project, the plan extension remains unchanged but the building becomes three floors above ground (with a height increase of 50%, from 10 to 15 m). For these reasons the altimetric development becomes predominant, in perceptive terms, over the planimetric one. The drawings show how Castagnoli, while creating a building with profoundly different proportions, is able to maintain all the formal elements of the existing building, even reusing them in the design of the elevation, creating a completely coherent and balanced composition and an unitary organism, without any discontinuity between the existing building and the added floors.

Creation of the semantic aware BIM model and its parametric families

The BIM virtualization of the Centrale di Città Studi is a semantically aware digital model, consisting of a collection of structured objects identified through an architectural vocabulary. Its implementation therefore composed by two parallel processes, a cognitive one of interpretation and recognition of the semantic elements that make up the architecture and an operative one for the generation of geometries [Inzerillo et al. 2016, p. 16.4]. Therefore, its realization, in addition to providing useful tools of representation and dissemination, has first and foremost worked as a tool to study the archive drawings. This methodology has proved particularly useful for windows, in fact the modeling of the related parametric families required first of all a careful analysis of the various types present, to identify similarities and differences. An arrangement of the main typologies into seven parametric families was carried out and in two cases these have been divided into several types, which differ in size or detail elements (fig. 5).

This work has shown how Castagnoli repeats in his composition some architectural elements similar to each other, declining them with some dimensional variations. Furthermore, these activities of architectural elements parametrization have the potential to create reusable 3D semantic libraries of historical architectural elements in the context of Heritage Building Information Modeling (H-BIM) [Santagati et al. 2018, p. 111]. Being a mid-20th century building, the use of libraries of standardized elements does not present particular complexities due to the uniqueness of the historical form [Attenti, Rossi 2019, p.189] as the construction techniques of the period were already based on the repetition of elements made by serial production.

Fig. 12. *Palazzo dei telefoni di Torino, analisi grafica del prospetto su via Mercantini (1943), (elaborazione grafica degli autori).*
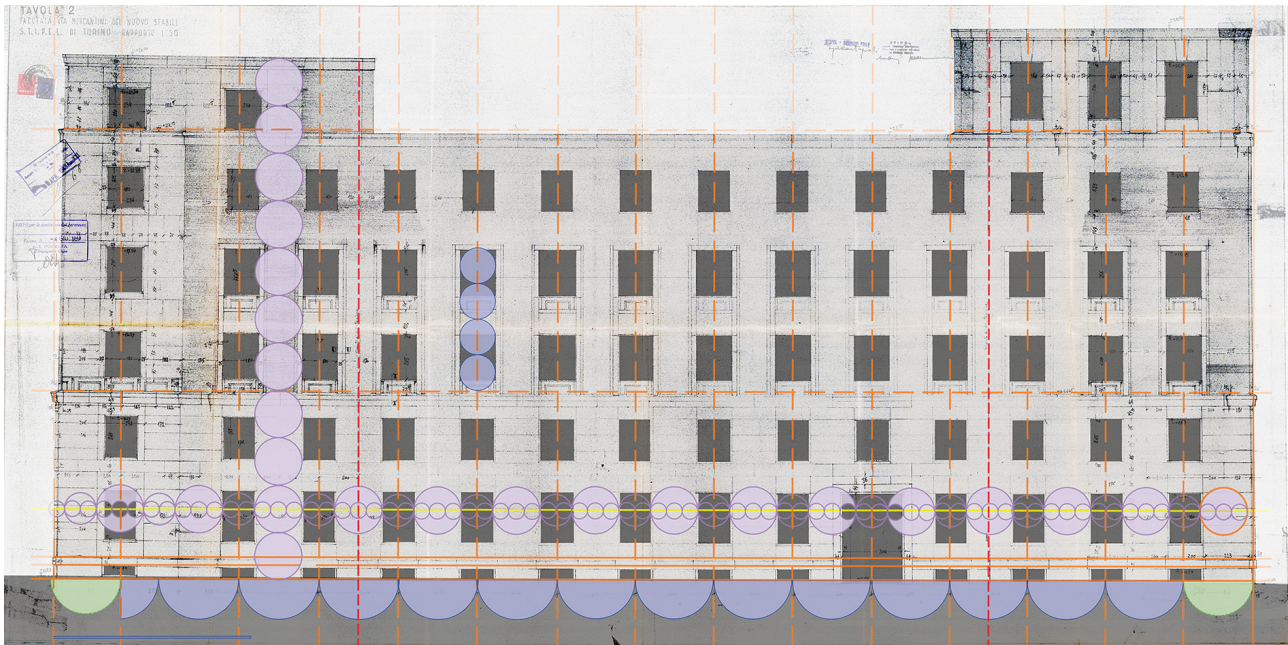
BIM model for three-dimensional digital representation: indoor and outdoor

The three-dimensional model was used as a basis for the creation of perspective images with Lumion, a real-time rendering software. This feature, together with the simple and intuitive interface and the rich pre-loaded libraries, makes the workflow very smooth, which is further facilitated by the Lumion LiveSync plug-in for Revit. It synchronizes the file with the BIM model in real time, so that each change is updated in real time, ensuring extreme interoperability between software.

This methodology was applied to create two images of the interiors (fig. 6), produced to analyse the spatiality of the distribution systems generated by a circular matrix. In fact, as already mentioned, the entrance and the staircase stand out from the archive drawings because their perimeters in plan are essentially defined by two circumferences. From the documents available, their geometric connotation on the horizontal plane is very clear but no other drawings or photographs, that describe the spatiality of these environments in three dimensions, are available nor at the moment it was possible to visit these indoor areas. Therefore, they have been modeled on the basis of the information available in the original drawings: through these images a first hypothesis on their three-dimensional development is therefore proposed, in order to enhance the strong geometric-compositional characterization of this spaces.

With the same methodology, a perspective view of the exterior of the building was also created, as it was built in 1943, before the raising project of 1962 (fig. 7). This image provides a clear view of the formal and material elements of the building at the time of its construction and allows to make a comparison, almost on the same level, with the current appearance of the building. It is evident that before the elevation, the angular volume was the highest central element and it dominated the composition, while the two lower volumes were joined on the two sides of it, like two similar wings. With the raising project of 1962, the angular volume becomes lower and smaller than the body on Via Spinoza, from which it is partially incorporated, losing its central role within the composition scheme. In this way the volume on via Spinoza becomes predominant while the wing on via Villani seems to be a small annex.

From archival drawings to survey: a comparison

In the context of this research, a further contribution can come from the architectural survey in its value as a document of the completed work. Figures 8-12 allow to compare the project drawings of the elevations of 1939 (first project) and 1962 (raising project) with the orthophoto processed by digital photogrammetry (Agisoft, Metashape, single model made with 190 shots). The overlaps between the survey data and the project data immediately shows the considerable metric differences: moving from the 1:100 scale drawing to an executive, a new design phase is evidently developed. During this the brick module, scrupulously used, re-proportions interaxle spacing and dimensions of the openings. On the east elevation, moreover, it is evident how, the simple 90° rotation of the brick, gives a perceptually much leaner and lighter loggia than the one planned.

This step of comparison between archival drawing and survey of the existing object, allows (as it naturally should be) to further increase knowledge on the culture of the project put in place by the architect in all phases of his work.

Comparison with the Palazzo dei Telefoni in Turin

From a comparison of the Centrale di Città Studi with the Palazzo dei Telefoni in Turin, it is immediately clear that the two buildings, both designed by Castagnoli for the same telephone company, have very different scales. Indeed, in their final configurations, they are respectively a three-storey building and an eight-storey one. The differences also concern the intended use, since the one in Città Studi is a telephone exchange, therefore a building intended to house only telephone systems and the necessary ancillary rooms, while the Palazzo dei Telefoni in Turin is the headquarters of the company and hosts its offices. Despite these differences in size and intended use and the consequent different level of representation that these buildings had for the company, it is possible to recognize a common architectural language, which characterizes Castagnoli's production and is adapted to the different contexts in which it is used. In both interventions, in fact, the architect's desire to blend harmoniously into the surrounding context is clear, even if it has not yet been built but only designed, relating dimensions, proportions

and materials with the neighbouring buildings. This intent is also demonstrated by the design drawings that depict his interventions alongside the neighbouring buildings, such as the Church of Muzio in the case of Città Studi, which was discussed above, and the pre-existing STIPEL headquarters, in the case of Turin [Incerti, Mei, Castagnoli 2021].

The graphic analysis of the façade of Palazzo dei Telefoni in Turin on via Mercantini (detailed drawings in 1:50 scale of the cladding, 1943, EdificaTo Archive) allows us to recognize the presence of the same compositional logic used in Città Studi. The rhythm of the facade (fig. 12) is given by the axis of the openings, according to a 4-meter module that actually derives from the grid of the reinforced concrete pillars. The solids/voids ratio is 3:2 and is sized and proportioned to the dimension of the brick that characterizes the third, fourth and fifth floors. As with the first building, the corner portions are treated with different modules. The openings, while always maintaining the same width, are progressively changed in height, probably

Fig. 13. Viste di insieme e di dettaglio del modello digitale del Palazzo dei Telefoni di Torino (elaborazione grafica degli autori).


due to the different light requirements from the first floor (2.56 m) to the sixth floor (2.20 m).

Finally, it appears evident that the author worked here according to a logic of "volumetric subtraction" from a main solid, which is progressively excavated as already done in the project for a Villa, presented at the 4th Triennale [Incerti 2016, p. 185].

The three-dimensional digital models of the two case studies were created with different methodologies: for Palazzo dei Telefoni in Turin, a NURBS surface modeling software was used (fig. 13). A comparison between this and the BIM modeling already described, allows to propose some reflections (certainly not exhaustive) on the theme of three-dimensional representation starting from archive drawings. Given that the purpose of the contribution is not to propose an in-depth comparison between modeling systems, the two experiences have allowed us to appreciate the advantages and disadvantages in the development of research on the design culture of the architect Castagnoli. Although both methodologies have proved effective in representation and dissemination, especially through three-dimensional views, BIM modeling has presented some particularly interesting aspects. First of all, BIM models are based on the semantic structuring of the constituent elements of the architecture and therefore lead, in this field of application, to a more in-depth knowledge of the real building, since they replicate "a digital model similar to the real one, not only in terms of the mimetic rendering of its configuration, but also in the intrinsic organization of its parts" [di Luggo 2018, p. 50, 51]. In BIM systems the representative moment does not only constitute the moment of graphic reconstruction of reality in the space of representation, but also the critical moment of identification of the formal structure of architecture and the constitutive relationships that substantiate it [di Luggo 2018].

On a purely practical-operational level, the possibility of a temporal structuring of the model, provided by the BIM environment, proved to be particularly useful in the analysis of the definitely difficult to interpret architecture, due to the countless project drawings that have followed one another over the course of more than two decades. Furthermore, the system of parametric families has favoured a careful comparison between the architectural elements of the building (in this epoch already based on serial repetition), automatically creating a useful catalogue for their analysis.
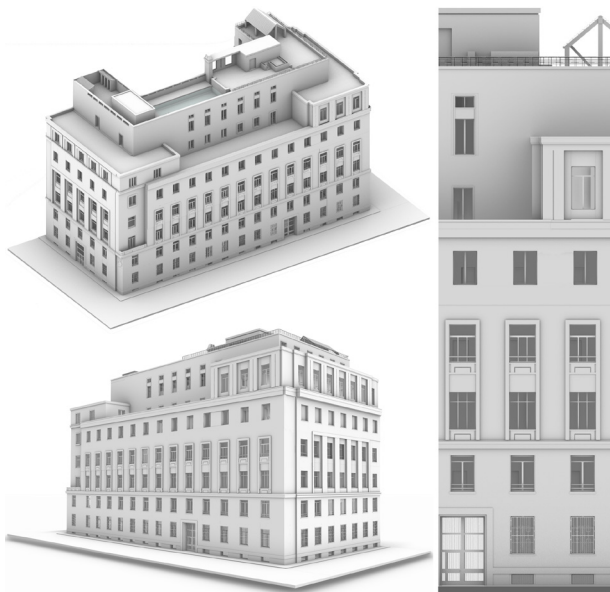
Conclusion

With this paper, the project of the Centrale Telefonica di Città Studi in Milan was analysed, systematising archival drawings, documents, surveys and techniques of two- and three-dimensional graphic analysis (with BIM methodology) in order to investigate the author's technical and cultural approach as well as his responses to external solicitations (see the case of Giovanni Muzio's *Templum Reginae Pacis Augustae*). This project was also briefly compared with the case study of the Palazzo dei Telefoni in Turin, for which different representation tools and methodologies were used. The work constitutes a further step in the context of a broader research on the projects of the architect Castagnoli and, given the first results achieved, it has been considered useful also to implement it with BIM methodology. Future developments could concern the construction of a shared abacus of parametric architectural elements that can be used for multiple models, as carried out in the work on the La Sapienza University complex [Valenti, Griffo 2020]: in this case the author would be the unifying element instead of the location of the buildings. A further outcome could concern the creation of a digital environment in which to catalogue the numerous archival documents by connecting them to the three-dimensional model [Bruno, Roncella 2019], with the aim of creating a tool capable of holding materials together, improving the accessibility of cultural heritage through digital tools. The BIM methodology can in fact constitute a bridge between archival documentation and the digital model [Parisi, Lo Turco, Giovannini 2019] and therefore a useful tool also in this lively field of research, as shown by the growing interest of scholars in 20th century architecture archives; the drawing is a document and, as such, a primary source for the in-depth study of the works, the trajectories of artistic movements and designers [Spallone, Bertola 2020].

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References List

Attenni, M., Rossi, M.L. (2019). La modellizzazione del patrimonio costruito. Processi BIM a confronto per tipologie architettoniche. In *Diségno*, n. 4, pp. 189-200.

Belli, C. (1935). Origini del gruppo 7. In *Quadrante*, n. 2 (23), pp. 32-39.

Bertola, G. (2020). Archives enhancement through design drawings survey, BIM modeling and prototyping. In *2020 IMEKO TC-4. International Conference on Metrology for Archaeology and Cultural Heritage (MetroArchaeo 2020) Proceedings*. Trento, 22-24 October 2020, vol. 2, pp. 66-71.

Betta, P. (1927). Il Gruppo "7" di Milano e l'Architettura Nuova. In *L'architettura Italiana*, n. 22 (2), pp.13-15.

Brumana, R. et al. (2013). From survey to HBIM for documentation, dissemination and management of built heritage: The case study of St. Maria in Scaria d'Intelvi. In A.C. Addison, L. De Luca, G. Guidi, S. Pescarin (Eds.) *2013 Digital Heritage International Congress Proceedings*. Marseille, 28 Oct -1 Nov 2013, pp. 497-504. IEEE.

Bruno, N., Roncella, R. (2019). HBIM for Conservation: A New Proposal

for Information Modeling. In *Remote Sensing*, n.11 <https://www.mdpi.com/2072-4292/11/15/1751> (accessed 9 April 2022).

Buffa, P, Cassi Ramelli, A. (1934). *P. Buffa e A. Cassi architetti. Rassegna di architettura* (numero monografico). Milano: Tip. Rozza di Corbella.

Buratti Mazzotta, A. (2013). La didattica del disegno edile e la cultura delle scuole tecniche nell'Ottocento a Milano. In C.G Lacaita, M. Fugazza (a cura di). *L'istruzione secondaria nell'Italia unita: 1861-1901*, pp. 258-273. Milano: FrancoAngeli.

Calcerano, F. et al. (2017). Heritage Bim: methodological reflections and interoperability with numerical simulations. In *Dienne*, n. 1, pp. 19-31. Roma: Dei s.r.l. Tipografia del Genio Civile.

Caneva, L. M., Griffini, E. A. (1930). *36 progetti di ville di architetti italiani*. Milano-Roma: Bestetti e Tumminelli.

Cartasegna, R., Santi, B. (a cura di). (2017). Franca Petocchi intervista Guido Frette. In *Guido Frette un razionalista a Tortona. Catalogo della Mostra*. Biblioteca Civica di Tortona 26.XI.2016 - 25.II.2017, pp. 33-45. Tortona: Città di Tortona.

Castagnoli, U., Frette, G. (1934). Nuovo negozio della Sartoria Spagnolini. In *Edilizia Moderna*, n. 14, pp. 28, 29.

Ciucci, G., Muratore, G. (2010). *Storia dell'architettura italiana. Il primo Novecento*. Milano: Electa.

di Luggo, A. (2018). Tra didattica e ricerca: i sistemi H-BIM per la documentazione del patrimonio architettonico. In T. Empler, F. Quici, G. M. Valenti (a cura di). *3D MODELING & BIM - Nuove Frontiere*, pp. 50-51. Roma: Dei s.r.l. Tipografia del Genio Civile.

Incerti, M. (2016). *Le ville del concorso della IV Triennale di Monza (1930). Disegno e modello nella comunicazione del progetto*. Bologna: Bononia University Press.

Incerti M., Mei G., Castagnoli A. (2021). Ubaldo Castagnoli e la piscina pensile del Palazzo dei Telefoni di Torino/Ubaldo Castagnoli and the Hanging Swimming Pool of the Palazzo dei Telefoni in Turin. In Arena A. et al. (a cura di). *Connettere. Un disegno per annodare e tessere. Linguaggi Distanze Tecnologie. Atti del 42° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Connecting. Drawing for weaving relationship. Languages Distances Technologies. Proceeding of the 42th International Conference of Representation Disciplines Teachers*, pp. 2367-2384. Milano: Franco Angeli.

Irace, F. (1994). *Giovanni Muzio 1893-1982*. Opere. Milano: Electa.

Inzerillo, L. et al. (2016). BIM e beni architettonici: verso una metodologia operativa per la conoscenza e la gestione del patrimonio culturale/Bim and architectural heritage: Towards an operational methodology for the knowledge and the management of cultural heritage. In *Disegnarecon*, n.16, pp. 16.1-16.9.

Istituto per le case popolari Milano (1933). *Il concorso pel nuovo quartiere Francesco Baracca a San Siro : progetti di massima pel nuovo quartiere Maurilio Bossi in viale Molise*. Istituto per le case popolari di Milano. Milano: Bertieri.

Moretti, G. (a cura di). (sd) *Studi di architettura della scuola superiore nella R. Accademia di Belle Arti e nel R. Politecnico di Milano*. Milano: Bestetti e Tuminelli.

Paolini, C., Pugnaletto, M. (2017). Reinforced brick light-weight vaults. In *Tema: Technology, Engineering, Materials and Architecture*, n. 3 (1), pp.124-136 <https://doi.org/10.17410/tema.v3i1.125> (accessed 9 April 2022).

Parisi, P, Lo Turco, M., Giovannini, E.C. (2019). The value of knowledge through H-BIM models: historic documentation with a semantic approach. In *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences. Atti del 8° workshop internazionale 3D-ARCH "3D Virtual Reconstruction and Visualization of Complex Architectures"*. Bergamo, 6-8 febbraio 2019, vol. XLII-2/W9, pp. 581-588.

Rassegna di Architettura (1931). La II Esposizione di Architettura Razionale Italiana alla Permanente di Milano. In *Rassegna Di Architettura*, n. IX (7), pp. 249-257.

Ricci, G. (2008). Una sede sofferta: dalla preesistenza a un nuovo insediamento urbano. In *Annali di storia delle universita italiane*, n. 12, pp. 27-44. Bologna: Clueb.

Santagati, C. et al. (2018). Assessment of workflows for creating 3D semantic libraries: A study on medieval bell towers in the central region of Sicily. In *MetroArchaeo 2018. International Conference on Metrology for Archaeology and Cultural Heritage Proceedings*. Cassino, 22-24 ottobre 2018, pp. 111-116.

Selvafolta, O. (2008). Una scuola per il progetto. La formazione tecnico scientifica al Politecnico di Milano. In E. Canadelli, Z. Paola (a cura di). *Milano scientifica, 1875-1924*. Milano: Sironi.

Selvafolta, O. (2012). Gli studi di ingegneria civile e di architettura al Politecnico di Milano. Territorio, costruzioni, architetture. In Ferraresi, A. (a cura di). *Le università e l'unità d'Italia, 1848-1870*. Bologna: Clueb.

Valenti, G.M., Griffo, M. (2020). Processi BIM nella definizione di modelli conoscitivi per l'architettura: aspetti formativi. In T. Empler, A. Caldarone, A. Fusinetti. (a cura di). *Data modeling & Management for aeco industry*, pp.176-190. Roma: DEI s.r.l. tipografia del Genio Civile.

Velo, U., Castagnoli, A., Incerti, M. (2020). Ubaldo Castagnoli. Dal Gruppo 7 alle architetture per le telecomunicazioni/Ubaldo Castagnoli. From Gruppo 7 to architectures for telecommunications. In Arena A. et al. (a cura di). *Connettere. Un disegno per annodare e tessere. Atti del 42° Convegno Internazionale dei Docenti delle Discipline della Rappresentazione/Connecting. Drawing for weaving relationships. Proceeding of the 42th International Conference of Representation Disciplines Teachers*, pp. 2869-2890. Milano: Franco Angeli.