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"STRUCTURAL FANTASIES" IN 20TH CENTURY ARCHITECTURAL HERITAGE: THE FORGOTTEN WORKS OF ENRICO CASTIGLIONI

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Highlights

This article focuses on the design process and construction history of the most significant works of the engineer and architect Enrico Castiglioni (1914-2000) that were built between 1950 and 1965 in Italy's Varese territory. The survey aims to provide fundamental knowledge for their appreciation in the context of 20th century architectural heritage and for the implementation of future tailored preservation strategies. The design- and construction-related analyses are based on local archival documents and the combined sources of the literature of the time.

Abstract

During the 1950s, the "made in Italy" reinforced concrete structures established itself around the world. As a consequence, fascinating Italian architects turned structural- and construction-based research into novel figurative conceptions. Enrico Castiglioni (1914-2000) was a distinctive interpreter of this collective phenomenon, but, although his work was significantly discussed in the literature of the 1950s and 1960s, it is today completely neglected. This paper presents construction-history surveys, providing a historical and technical narrative of Castiglioni's built work.

Keywords

Enrico Castiglioni, Construction history, 20th Century architectural heritage, Reinforced concrete, Italy.

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1. INTRODUCTION

In the 1950s, when large "made in Italy" reinforced concrete structures became icons of structural engineering and when Italian engineers established themselves worldwide as master builders who developed expressive languages through construction innovations [1, 2], a sort of "structural imagination" spread through modern Italian architecture [3, 4]. Meanwhile, even beyond Italy's borders, "structuralism" in architecture (defined as an actual structural tendency embodied by reinforced concrete) established itself as a global trend in the modern movement to devise functionalist architectural forms [5–7].

In this context, the Italian engineer and architect Enrico Castiglioni (1914-2000) joined the dialogue with a series of projects – for the most part unbuilt "structural fantasies" – that received consistent attention in the technical literature of the time and the international discourse of architectural structuralism. The first main publications of Castiglioni's work, in the mid-1950s, were related to the 1954 Italian design tender for the new Naples central

railway station [8]. In his attempt to illustrate the particular structural body of the presented design, Castiglioni produced an impressive series of images of a physical model representing the free-form, reinforced concrete vaulted roofing of the station building. These images were appreciated by the influential Italian architect and critic Bruno Zevi (who was involved in the same tender) and they were printed as the cover image of the first issue of his architectural journal, *L'Architettura: cronache e storia*, dated June 1955 [9]. Thanks to the "structural tendency" that was informing the architectural discourse, the iconic image made possible the dissemination of Castiglioni's work to the international scene through a series of monographs published in a wide range of international technical journals [10–12].

In 1960, in the first edition of his essay *Strukturformen der modernen Architektur*, the engineer and critic Kurt Siegel included two unbuilt structures designed by Castiglioni. Characterised by an unusual "structural accomplishment of spaces of great architectural significance", the two projects were listed in a world ranking of the most attractive structural architecture of the time [13]. On 5 April 1962, even Ernest Neufert took his students to visit a construction site of Castiglioni's work [Castiglioni Private Archive, Letters, E. Neufert, 1962]. In 1965, the critic Udo Kultermann chose Castiglioni's 1959 design of the Istituto Tecnico Industriale Cipriano Facchinetti school building as the cover image of his book *Neues Bauen in der Welt* [14]. Then, in 1967, Castiglioni's work was included (with a dedicated headword) in the first edition of the *Dictionary of Architecture* by Jhon Fleming, Hug Honour, and Nikolaus Pevsner [15]. This tribute of international criticism faded over time and disappeared by the 1980s [16]. In 1979, the editors of the

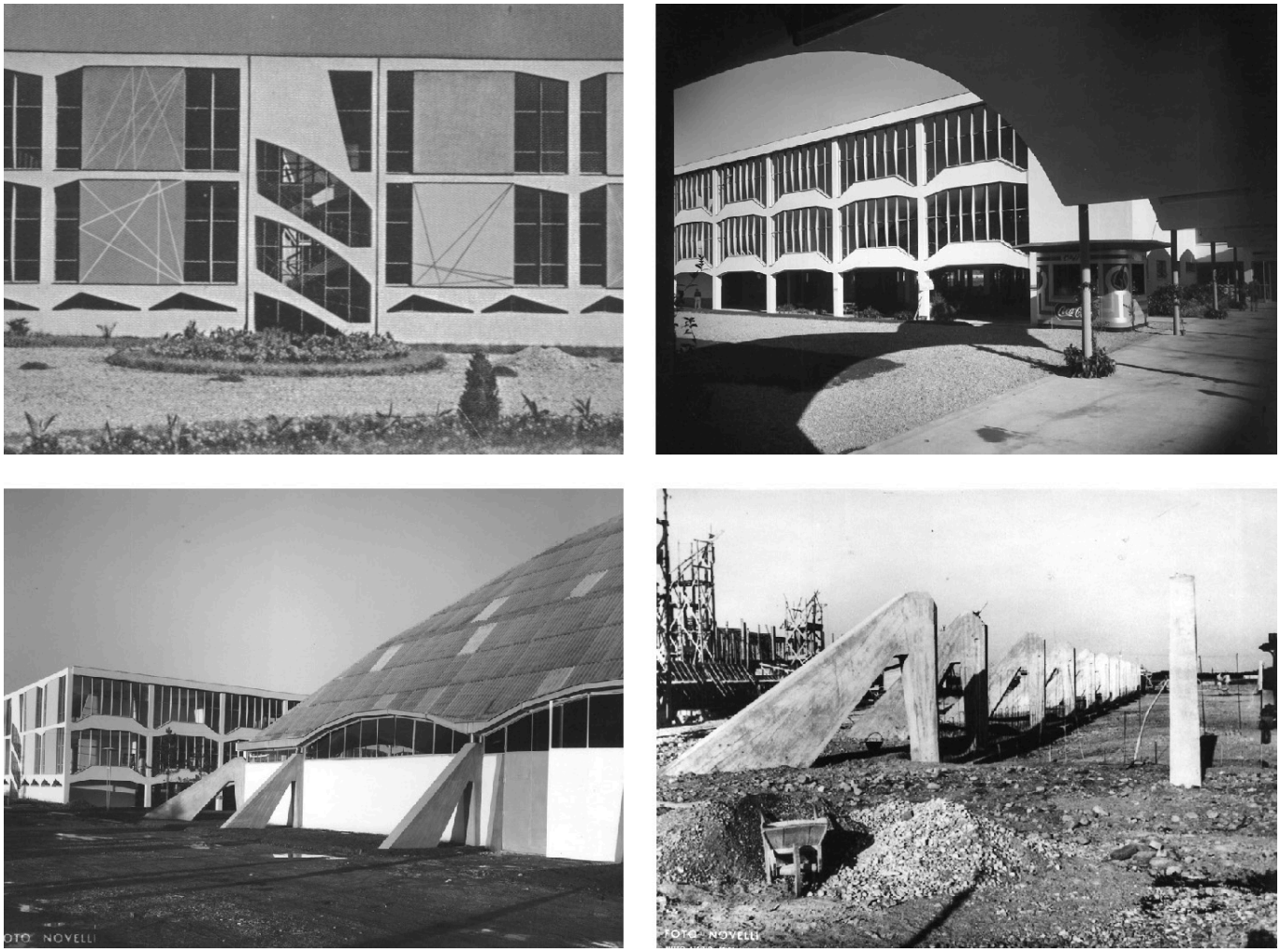

Fig. 1. ˝Mostra Internazionale del Cotone e del Rayon˝ *building in Busto Arsizio, 1951-1954, demolished in 2015. From the top and from left to right: external views of the buildings and construction site of the main vaulted pavillion (courtesy of Castiglioni Private Archive).*

magazine *Domus* organised the exhibition *28/78 Architettura*, showcasing fifty years of architecture in Italy [17]; Castiglioni's work was considered in a monograph alongside the work of Nervi, Mangiarotti, Mollino, Mollino, Moretti, Ponti and Scarpa. After this last acknowledgement, Castiglioni's work was gradually forgotten, and no complete, dedicated retrospective has yet been produced [18–20]. (As material proof of this historical neglect, in 2015, the complex of the Mostra Internazionale del Cotone e del Rayon in Busto Arsizio (Fig. 1), dated 1952-1955 and considered irreparable due to a lack of maintenance, was demolished, removing all evidence of the original structure of Castiglioni's most impressive work without any acknowledgement of its technical and historical value). In this context, the following pages analyse the design processes and construction histories of Castiglioni's most significant works, illuminated by the literature of the 1950s and 1960s [10–17]. These surveys, based on the literature of the time and local archives (Castiglioni Private Archive, Busto Arsizio, and Gorla Minore Municipal Archives, Varese State Archive), provide foundational knowledge for the cultural appreciation of Castiglioni's heritage and tailored preservation strategies for his buildings currently in use.

2. THE "STRUCTURALIST INFERENCES": FIRST WORKS (1950-1954)

Castiglioni was born in 1914 in Busto Arsizio in the province of Varese. After taking his first degree in civil engineering at the Polytechnic of Milan (1937) and qualifying for the profession of architect in Rome (1939), he concentrated almost all his professional activity in the land of his birth. In the post-war period, the self-sufficient development of the provincial territory, directly governed by local engineers and architects, guaranteed him a continuity of work that, between the early 1950s and the mid-1960s, engaged him in the construction of buildings for the development of the collective life of small municipalities (churches, sports facilities, and primary schools). At the same time, he participated in a long series of design competitions in which his most celebrated "structural fantasies" took shape [10–15]. As noted in the first monographic review of Castiglioni's architecture (in the December 1955 issue of *L'Architettura: cronache e storia*), his first works displayed an evident "ease in inventing structures" [10].

Castiglioni's first built work was an expansion of the Rosetum institute in Besozzo (1950). In the design of the complex's new chapel, the concept of the internal space was characterised by the contrast between two structural systems: a corrugated shell roof and a beam-and-pillar frame. The roofing shell comprises a series of ten round transverse vaults, three meters in diameter, made of eight-centimetre-thick prefabricated brick arches set on reinforced concrete bond beams. The succession of the vaults, defined by Castiglioni as a "folded but never rigid sheet structure" [Castiglioni Private Archive, Rosetum, Technical Report, 1951], therefore rests on the longitudinal beams that run parallel to the perimeter walls and connect to the pillars, forming an autonomous frame (Fig. 2).

Fig. 2. *Rosetum chapel in Besozzo, 1950-1951. Interior views (courtesy of Castiglioni Private Archive).*

The same combination of two structural systems (the thin vault and the exposed frame) was developed, with original results, in the enlargement of the sixteenth-century church of Viggiù (1952), consisting of a new rectangular hall (eight by twenty meters) with small side rooms. The spatial conception of the hall is based on the combined use of a thin, sinuous, reinforced concrete vault with ten hefty tripartite supports (inverse tripods). Seen from the front, each inverse tripod, originating from a single support on the ground, consists of a vertical and flared central pillar and two inclined and tapered lateral arms that extend outwards, forming a V-shaped support (Fig. 3). Thus, if we imagine a transverse section of the structure, the central pillar of the tripod, because it remains detached from the perimeter wall, rises vertically (up to 7.25 meters) to the springer of the central vault while the two arms tilt outwards until they re-join the perimeter wall. On the one hand, the sequence of V-shaped supports constitutes the lateral support of the system of prefabricated brick arches that define the wavy edge of the perimeter wall above and the roof of the side rooms. On the other hand, the central pillars join the thickest sections of the undulating vault characterised by longitudinal reinforcement, forming the stiffening system of the roof. In terms of spatial conception, the combination of robust tripods and the thin vault is marked by the placement of large windows that allow a diffusion of light, which grazes the roof curves and underlines the figure of the "strictly static membrane" [10] devised by Castiglioni.

A data comparison of the original drawings of the vault's contour lines (Fig. 3) with construction site pictures showing the complex curvilinear wooden ribs placed to support the cast-in-place roof (Fig. 4) discloses the modular conception of the vault. A single bay between two tripods was designed as a combination of simple geometric sectors: a barrel vault, a small, lowered dome, and a saddle surface between them. The juxtaposition of the vault sectors in each bay with the overall composition of the four bays is thus indicated by the positioning and shaping of the reinforcements; the domes are characterised by circular reinforcements while the stiffening sections of the roof are marked by major transverse reinforcements. A 3D model analysis (Fig. 4) confirms the efficient modular conception of the apparently free-form vaulted geometry, deepening the interpretative understanding of Castiglioni's design approach [13, 17], and the refined carpentry of the impressive wooden centring confirms the artisanal inner construction of the structure. As soon as the Viggiù building was completed, Castiglioni committed to the 1954 competition project for the Naples station, in which a pattern of thin vaults spanning twenty-five meters and anchored on monumental inverse tripods forms the impressive roof of the station building (Fig. 5). If the affinity of the station building with the structure designed for the small church is evident even when looking only at pictures of the physical model, the present analysis, retracing the similar modular composition of the free-form vaulted roof [13], reveals in the

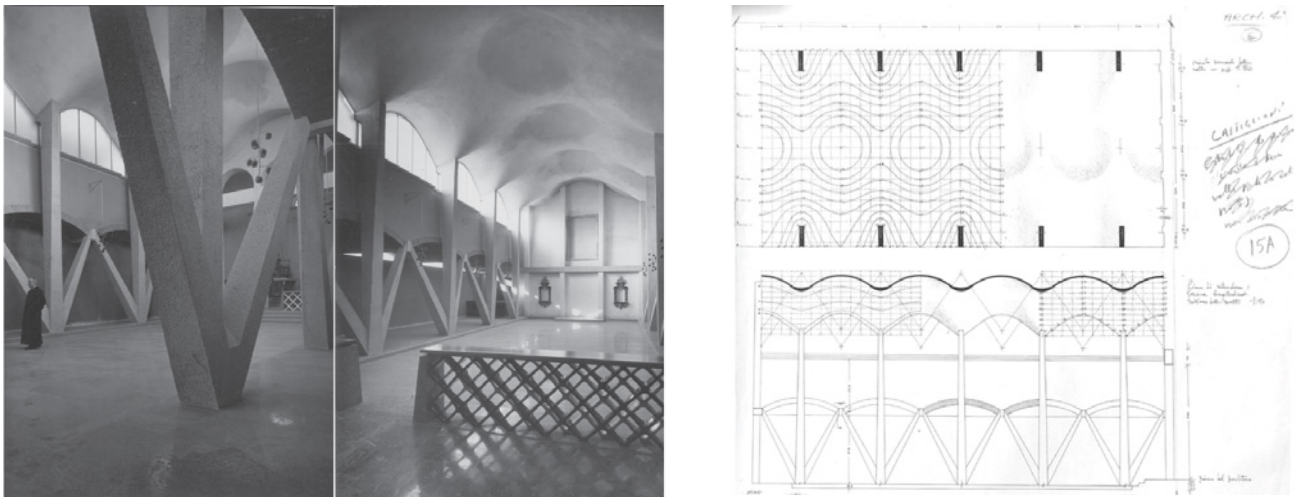

Fig. 3. *Viggiù church, the new chapel, 1952-1953. From left to right: interior view and drawing for the geometry of the vaults (courtesy of Castiglioni Private Archive).*

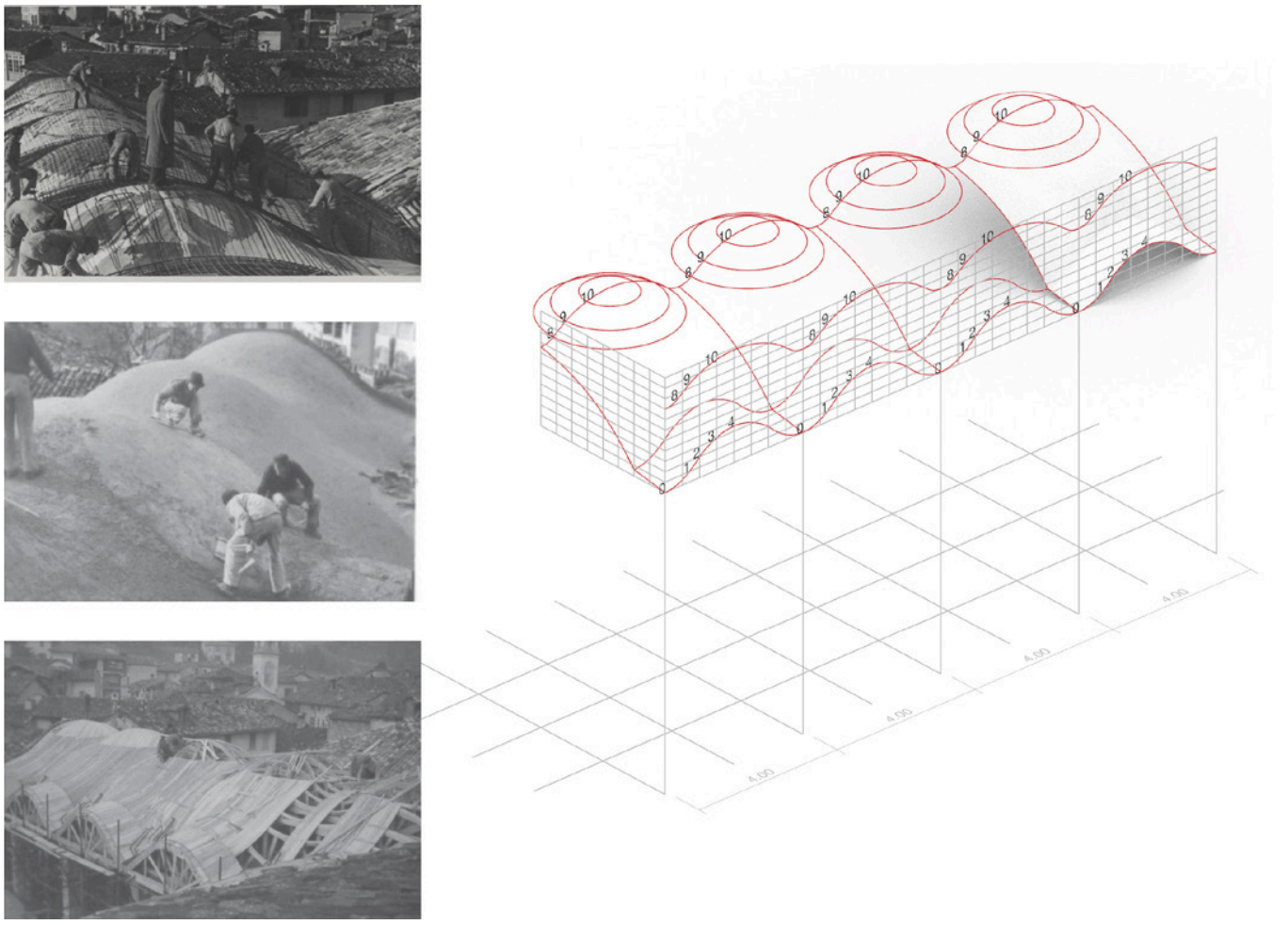

Fig. 4. *Viggiù church, the new chapel, 1952-1953. From left to right: construction site pictures (courtesy of Castiglioni Private Archive) and 3D study of the vaults geometrical conception (the author, 2020).*

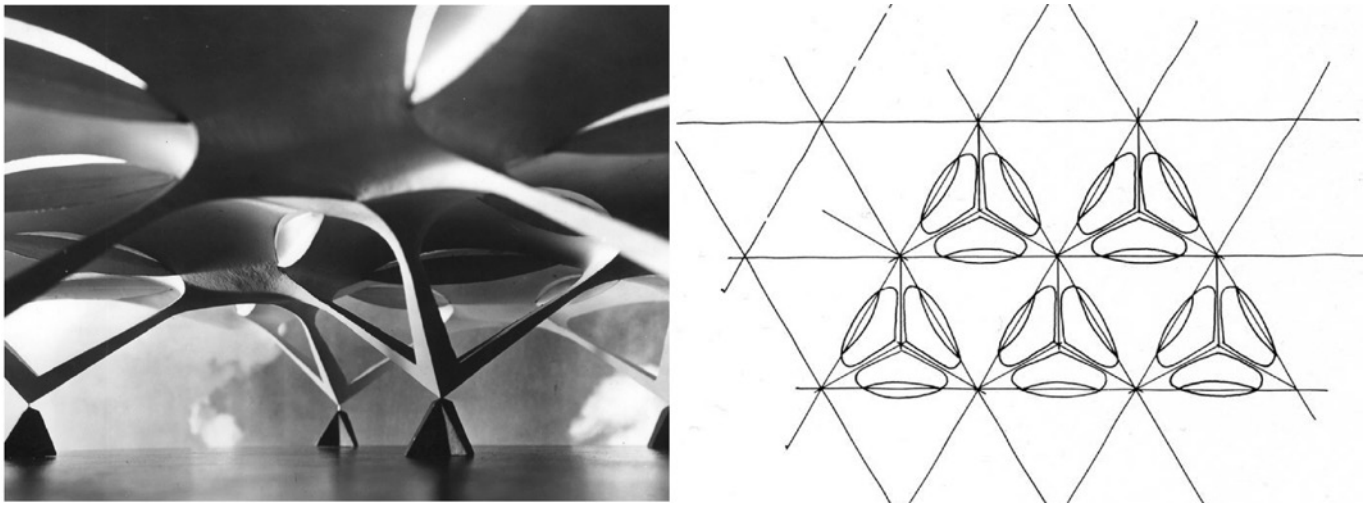

Fig. 5. *Napoli station competition design, 1954. From left to right: picture of the study model (courtesy of Castiglioni Private Archive) and sketch, by K. Siegel, explaining the modular-based design approach [13].*

neglected church hall a miniature-built prototype of the celebrated Naples structure.

In 1953, Castiglioni was commissioned to design the *Casa della Cultura Cattolica* (House of Catholic Culture) in Busto Arsizio. The small, two-story building is characterised by a mixed frame in reinforced concrete and granite [10], conceived by Castiglioni and calculated by the engineer Alberto Cugini. The structure,

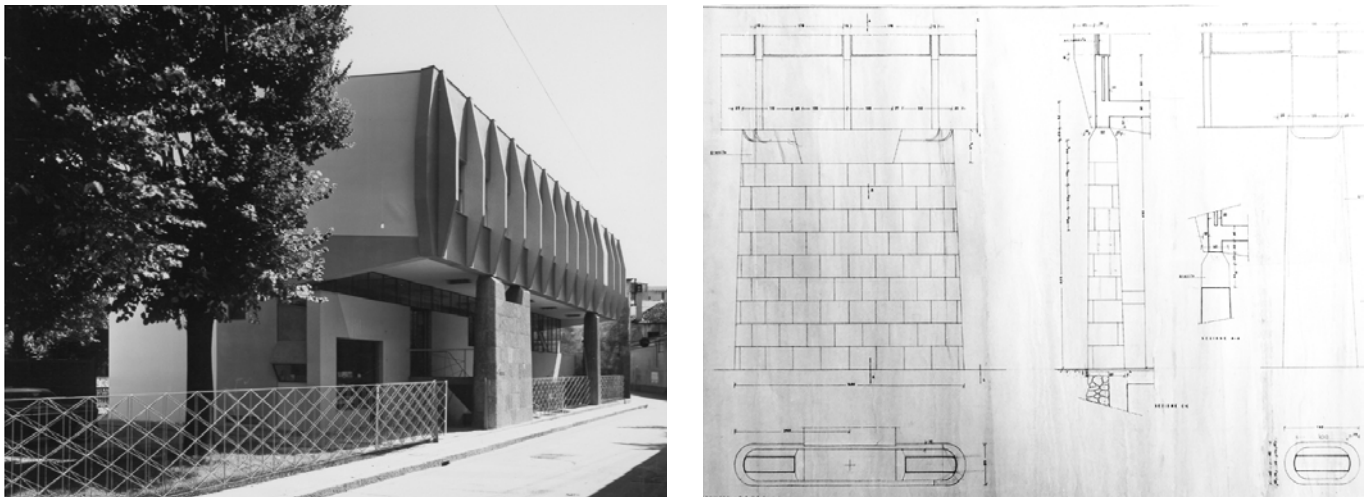

Fig. 6. ˝Casa della Cultura Cattolica˝ *building in Busto Arsizio, 1953-1955. From left to right: façade view and study drawing of the granite pillars (courtesy of Castiglioni Private Archive).*

although of "orthodox conception" [Varese State Archive, Prefettura, Casa della Cultura Cattolica, 1953], has a continuous overhang on the road-facing front of the building, supported at the ends by two sturdy brackets and, in the intermediate areas, by two sturdy granite pillars, the first monolithic and the second, made of reinforced concrete, covered with the same Quasso stone (Fig. 6). A series of reinforced concrete slats, resting on the granite pillars, marks the façade of the projecting body; the front of the structure, as it was conceived, was described by Giancarlo Ortelli with the term *decorazione-struttura* [10] to indicate the figurative use of the structural elements, that affected the pure relation between the shape and structural function. Even Zevi mentioned the small building for its "structural inferences" [5].

3. "STRUCTURAL DECORATIONS" (1955-1958)

Ortelli's definition is also consistent with an analysis of the works of the immediately subsequent years; original structural decorations tried out in the *Casa della Cultura Cattolica*, were developed in two primary school projects built between 1955 and 1959 in Busto Arsizio [21] and Gorla Minore [22].

The first building, designed with the engineer Dante Brigatti (director of the technical office of Busto Arsizio municipality), is in fact recognisable by the design of two original portals, in the shape of a Greek P, located outside the main classroom façades (Fig. 7).

These elements – eight meters high, with a five-meter span and 3.75 meters of symmetrical overhang beneath a sturdy honeycomb frieze – are characterised by a general over-dimensioning with respect to their structural function. The portals, designed as double overhanging frames hinged at the base, support only the 6.25-meter roof spans of the classrooms. The structural dimensions were, in fact, defined as "architectonic" in the calculation model in which it was also determined to disregard the horizontal beam bending moment decrease due to the contribution of the side overhang [Busto Arsizio Municipal Archive, Primary School in Rione Sempione, Technical Calculation Reports, 1955]. From a design perspective, while the dimensional evidence heightens the architectural expressiveness of the portal, the shape evokes its real structural behaviour, announcing itself as a *decorazione-struttura* [10]. Under the weight of the sturdy frieze, the stringer of the portal inflects, and the pillars, still imagined as though they were free at the base, consequently open outwards to where the two sturdy plinths absorb the horizontal forces, keeping the system in balance. All the elements were cast in place as the price of labour was competitive at that time in the Varese district, even for skilled workers (a carpenter or blacksmith cost 408 lire per hour), which made possible the economical formation of "pillars, beams and any reinforced concrete element of any section and shape" as well as the tailored

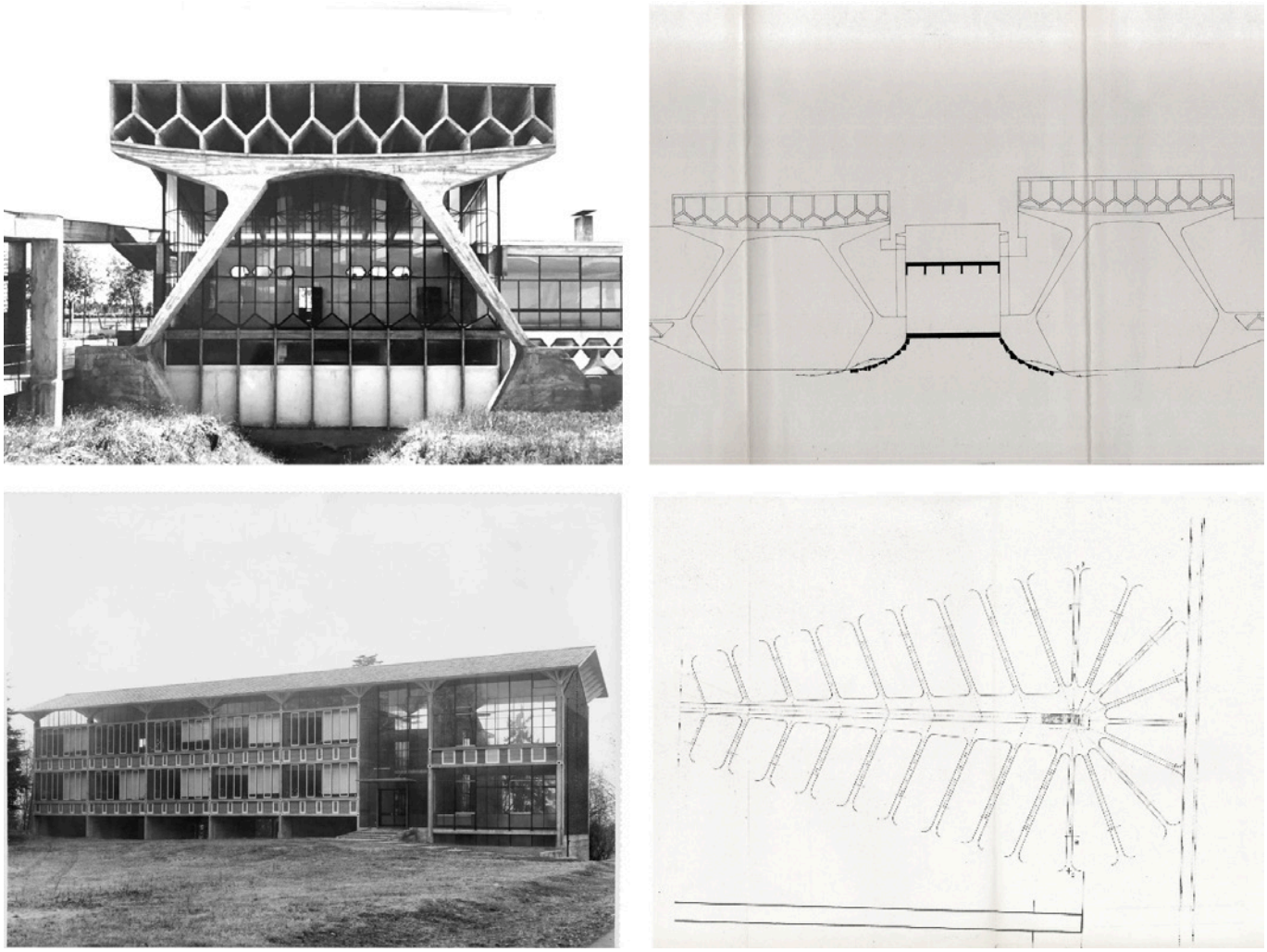

Fig. 7. *Busto Arsizio primary school in Sempione district, 1955-1958. From left to right: view and drawing of the main façade (courtesy of Castiglioni Private Archive); Gorla Minore primary school in Parco Durini,1956-1959. From left to right: external view and crowning detail drawing (courtesy of Gorla Minore Archive).*

designs of the iron-profile window and door frames [Busto Arsizio Municipal Archive, Primary School in Rione Sempione, Technical Prices Report, 1955].

A similar use of structural decoration characterises the primary school project commissioned to Castiglioni by the municipality of Gorla Minore in 1956 [20]. The project, to be carried out in the eighteenth-century park of Villa Durini, was subject to the preliminary requirements and approval of the Superintendence, including the need to favour the perception of the slope of the park towards the valley, to make the outer walls of "selected bricks" and to give the façade "noble decorative elements". The suggestions, accepted by Castiglioni, were applied in the original concept of the building's structure. Eight large, load-bearing walls, in a comb-like arrangement according to the direction of the slope of the park, formed the elevated structure, allowing the body of the building to be traversed physically and perceptually.

A continuous brickwork texture, framed by a reinforced concrete structure, ennobled the load-bearing walls on the transverse façades, repeating itself in the atrium, and a genuine decorative element was designed as a crowning structure (Fig. 7): eight lamellar flower capitals, at the load-bearing walls, partitioned the façade in a large-scale order and became the crowning cornice of the transverse façades and the atrium. Castiglioni intended that the frieze and capitals would be part of the roofing system, as conceived in a first draft that involved extending the design of the flower capitals into a thin, variously curved ribbed shell that remained unbuilt.

4. "SYMPATHY FOR REINFORCED CONCRETE": LAST WORKS (1960-1964)

In 1961, with the support of the influential Italian architect Gio Ponti, Castiglioni was commissioned for the project of the parish church of Prospiano in Gorla Minore. The church, in the shape of a basilica, is characterised by compact external stereometric and marked by a gable roof and by the fusion, in the internal space, of three naves in a single vaulted inner space characterised by a combination of opposing calottes associated with the conduct of liturgical events (Fig. 8). The structure features a thin barrel vault system and a load-bearing roof frame system. As detailed in the reinforcement drawings, the overlapping of the two structural systems created a design that was now far from the explicit structural compositions of the 1950s [13].

That Castiglioni's "structural visions" were no longer adequately supported in the early 1960s by building experimentation (which had constituted the necessary design training at the beginning of the previous decade), is also shown in the results of the A.I.T.E.C (*Associazione Italiana Tecnico Economica del Cemento award*), reserved to works in reinforced concrete, for which Castiglioni competed in 1962, earning only a special mention by the jury. "The natural sympathy that Castiglioni enjoys for reinforced concrete", which inspired the publication of a long story about the mostly unbuilt designs in the journal *L'industria Italiana del Cemento*, cannot compensate for the obvious shortcoming of the construction [23, 24].

Castiglioni's last works date, prematurely, from the mid-1960s. A last major construction site was the im-

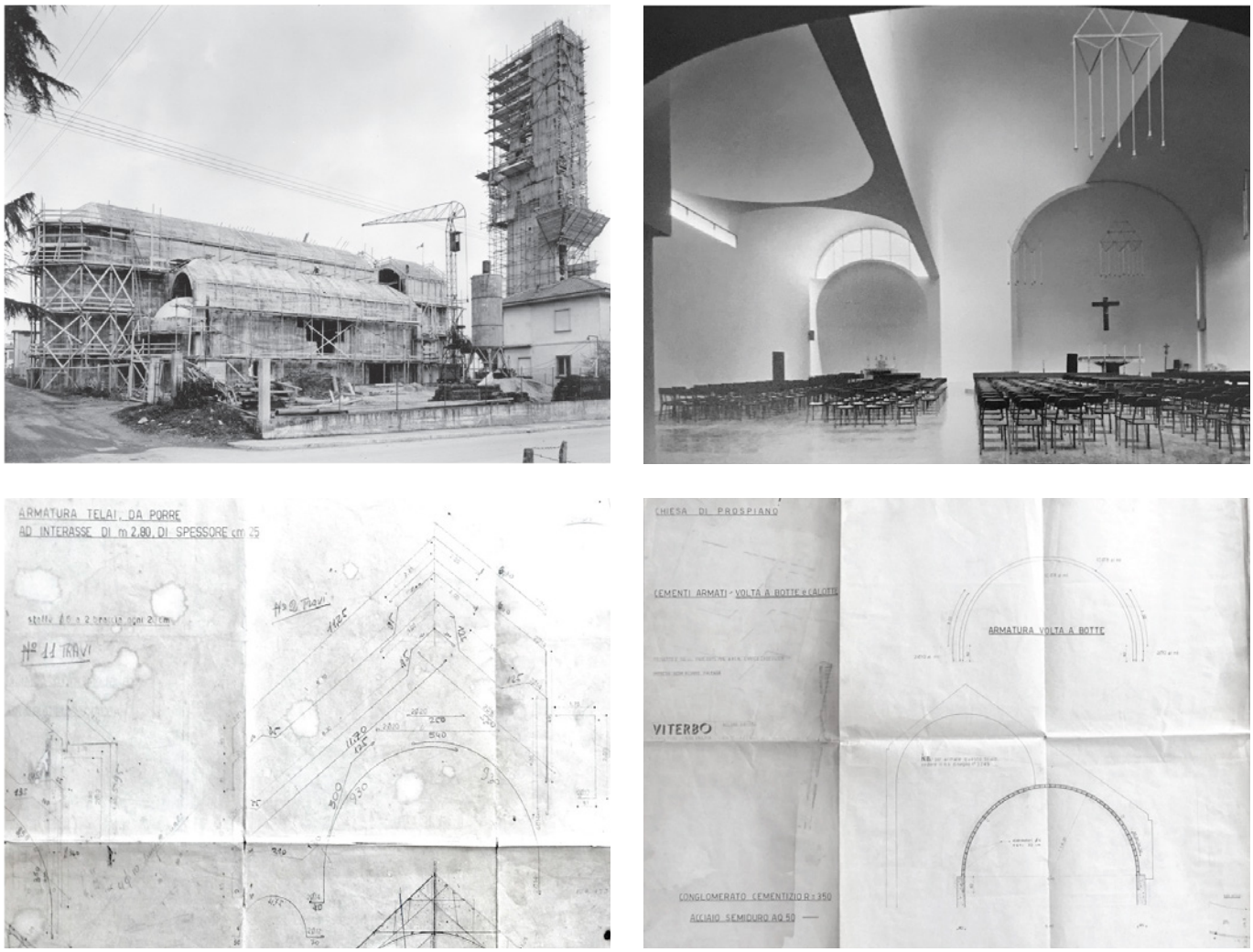

Fig. 8. *Prospiano Church in Gorla Minore, 1959-1965. From the top and from left to right: construction site view, interior view, cross-sections with reinforced concrete reinforcements details by the engineer Viterbo (courtesy of Gorla Minore Archive).*

posing *Istituto Tecnico Industriale Cipriano Facchinetti* (ITIS) school building in Castellanza. Designed in 1959 and constructed between 1962 and 1966 with the support of the engineers Carlo Fontana and Oreste Viterbo, the complex is Castiglioni's most impressive (and well-known) work. It consists of two symmetrical buildings that flank the porticoed atrium; the two buildings have a novel inverted T-section in which the highest central core, split longitudinally by a zenithal fissure, connects to two lateral wings with a curvilinear roof (Fig. 9). A system of reinforced concrete vaults and reinforced brick elements is combined in a rigorously modular approach with an imposing reinforced concrete frame characterised by curvilinear elements. Each half of the building has an independent structure, and the roofing of the central core comprises cantilever-reinforced concrete beams supporting prefabricated brick arches. The half-building structure is composed of four base modules, each of which is formed by three imposing frames in a comb-like arrangement supporting four reinforced-concrete conical vaults that cover the laboratory spaces on the ground floor and the frames of the building's three classroom floors [Archivio Privato Castiglioni, Study model of the building structure, 1960].

The school was completed in 1966 and, due to its impressive reinforced concrete structure, was soon recognised as an icon of architectural Brutalism [14, 15], although the original design of the building, significantly modified to accommodate economic constraints in its construction, would probably have inspired a different critical interpretation. Indeed, the school building was built in two phases, between 1962 and 1966, when the labour conditions in the Varese province had drastically changed. The

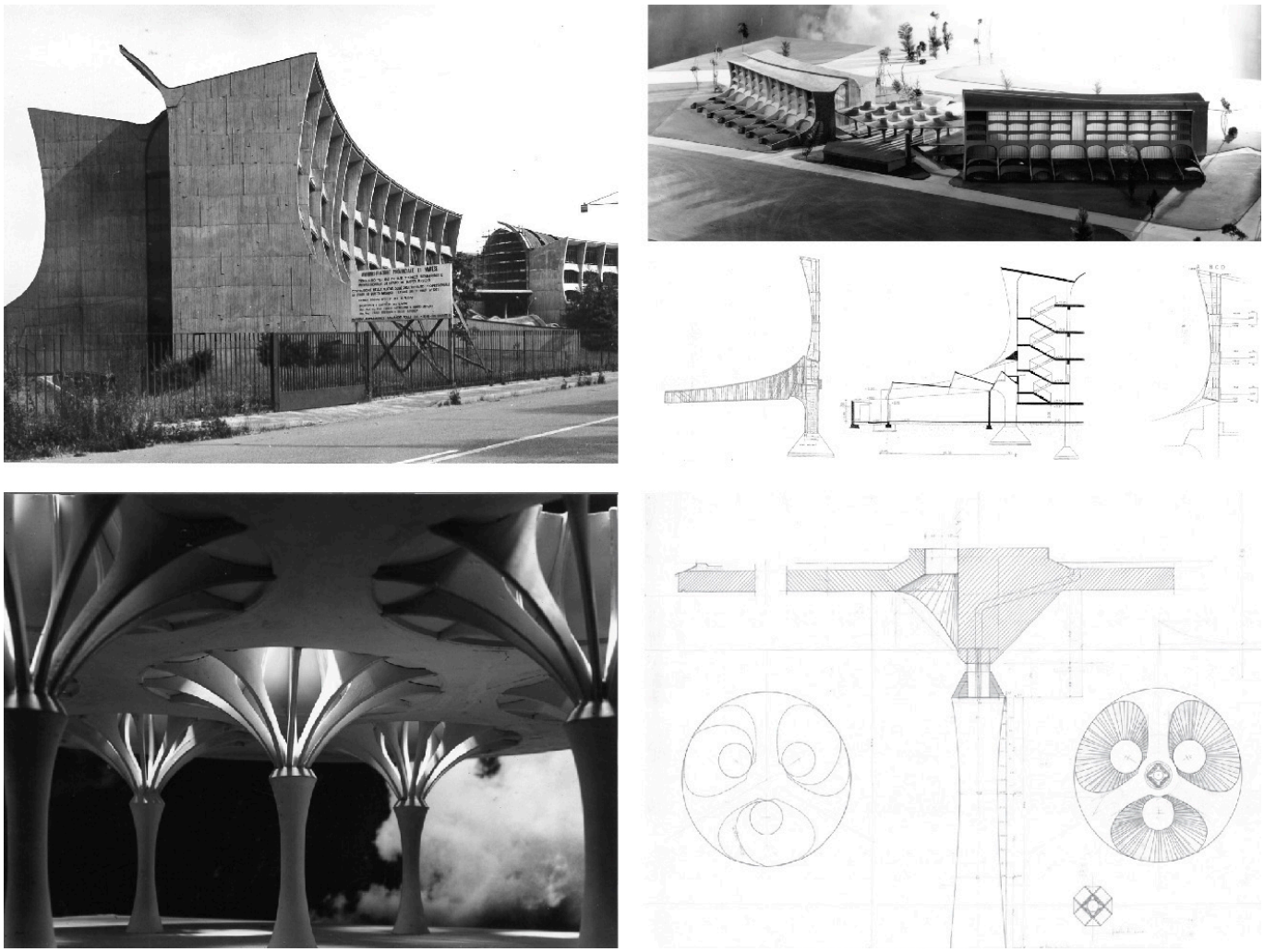

Fig. 9. *ITIS school in Castellanza, 1959-1966. From the top and from left to right: external view, study model and structural drawings by the engineer Fontana (courtesy of Castiglioni Private Archive); study model of the original design and drawing of an intermediate design hypothesis of the unbuilt pillar-skylight of the atrium (courtesy of Castiglioni Private Archive).*

cheap labour exploited for the primary school buildings of Busto Arsizio and Gorla Minore was no more, leading Castiglioni to abandon, during construction, the main "structural decorations" imagined in the original design.
In that design, a pillar-skylight, consisting of shaped slats on a conoidal volume, would have formed the floral ceiling of the porticoed atrium (Fig. 9). With a fully examined construction process relying on the use of special plaster formworks, the element would have been built through the off-site construction of the shaped slats, which would have been set in place without any scaffolding. In 1962, the structural object was drastically simplified to be cast in situ in a novel economic solution; by completely renouncing the pillar function of a skylight, the atrium roofing was set on a new series of completely filled conical calyx capitals. Even the coloured marble envelope that would have partially covered the exposed reinforced concrete of the external façades was eliminated in construction and only the design of the windows frames was built as originally designed, giving evidence of the original decorative conception of the whole [Castiglioni Private Archive, ITIS, Technical Reports, 1959]. The window frames, all made of FerroFinestra profiles and using the cheapest glass panes available on the market, saturate the entire space between the reinforced concrete frames. In the transversal façades, windows over twelve meters high are supported by a spatial reticular structure formed by four trusses, which are connected by a series of tie rods and arranged in decorative framed buttresses to absorb high wind loads. The Istituto has been extensively refurbished in recent years with the replacement of most of the original windows frames and with a white

Fig. 10. *Gorla Minore primary school after original windows frames refurbishment in 2016 (photo by Schüco company, courtesy of Gorla Minore Archive); Busto Arsizio Primary school in 1958 (Courtesy of Castiglioni Private Archive) and after windows original frames demolition (photo by the author, 2019).*

covering on the exposed reinforced concrete, testifying to the lack of historical and technical knowledge of Castiglioni's work among those in charge of the institution.

5. CONCLUSIONS

The present study of Castiglioni's built works provides the first material narrative of this overlooked building heritage of the Varese district. The surveys improve awareness of the 20th century Italian architectural heritage by telling a still neglected local story while also providing fundamental knowledge for tailored preservation interventions to correct the antithetical approaches taken by the institutions in charge (Fig. 10).

In this framework, the presented analysis of construction history led first to project- and construction-related consideration of Castiglioni's work, adding further perspective to the interpretations presented in the literature [17–19]. By referring necessarily to future surveys (currently being conducted) of the unbuilt projects, the analysis shed light on a rigorous, modular-driven design in which historical structural typologies (such as barrel vaults, sail vaults, and domes) overlap with reinforced concrete structural elements (such as frames and saddles) in clear, geometrical compositions. Furthermore, the non-ideological use of construction technology was underlined in the transition from the design conception to the edifice. The combined use of prefabricated brick elements, site-cast reinforced concrete structures, ad hoc designed wooden formworks and off-site produced structural elements supported by metal or plaster formworks as well as the tailored design of iron elements disclose a pure, craft-driven approach grounded on the proximity of the skilled artisans of the Varese territory.

From the perspective of applied preservation, the foundational material knowledge obtained in this study suggests the adoption of tailored interventions for buildings currently in use. The detailed documentation available in the local archives, as disclosed by this research, makes possible a base level of technical knowledge related to architectural, structural, and building material details (Fig. 11).

Works	dates	Castiglioni Archive	Municipality Archive	Varese *Prefettura* Archive	Ap	Sp
1	1950-1951	AD/DR/Pfb	/	/	Ld	/
2	1951-1953	AD/Pfb/Pcs	/	TR/MT	C	C
3	1951-1953	AD/Pfb	AD/TR	TR/MT	C	C
4	1950-1951	AD/DR/Pcs/Pfb	/	/	C	Lm
5	1955-1959	AD/Pcs/Pfb	AD/SD/DR/TR	/	C	Lm
6	1956-1959	AD/Pfb	AD/SD/DR/TR	/	C	Lm
7	1959-1964	AD/Pfb	AD/SD/DR/TR	/	C	Lm
8	1959-1964	AD/SD/DR/Pcs/Pfb	/	TR/MT	C	C

LEGENDA

Works		Archival documents		Abbreviations	
1	*Rosetum* in Besozzo				
2	*Mostra del Cotone e del Rayo*n in Busto Arsizio (demolished)	AD	Architectural Drawings		
3	*Casa della Cultura Cattolica* in Busto Arsizio	SD	Structural Drawings	AP	Architectural Project
4	Church in Viggiù	DR	Design Reports	SP	Structural Project
5	Primary School in *Rione Sempione*, Busto Arsizio	TR	Technical Reports		
6	Primary School in Gorla Minore	MT	Test on building material	Ld	Lacking in details
7	Church of Prospiano	Pcs	Construction-site photos	Lm	Lacking in building material details
8	ITIS School in Castellanza	Pfb	Finished building photos	C	Complete in details

Fig. 11. *Acquired technical knowledge levels, of presented buildings, from the archival sources-based surveys (2019).*

A future applied development of this study may consist of the improvement of digital-model investigation tools [25] for storing and easily sharing archival source data with local institutions charged with the maintenance and appreciation of this local architectural heritage.

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7. REFERENCES

[1] Iori T, Poretti S (2017) L'ingegneria italiana tra positivismo e umanesimo (Italian structural engineering between positivism and humanism). In: Iori T, Poretti S (eds) SIXXI 4. Storia dell'ingegneria strutturale in Italia (History of structural engineering in Italy). Gangemi, Roma, pp 9–25

[2] Iori T, Poretti S (2016) Storia dell'ingegneria strutturale italiana. Ascesa e declino (History of structural engineering in Italy. Rise and fall). In: Iori T, Poretti S (eds) La Scuola italiana di Ingegneria (Italian School of Engineering). Rassegna di Architettura e Urbanistica 148(1): 8–52

[3] Poretti S (2007) Architettura e struttura in Italia negli anni cinquanta e sessanta (Architecture and structure in Italy in the fifties and sixties). In: Pogacnik M (ed) Adalberto Libera, Sergio Musmeci, Il palazzo della regione Trento. Tra antico decoro e nuove figure strutturali (Adalberto Libera, Sergio Musmeci, *Il palazzo della regione Trento*. Between ancient decoration and new structural figures). Nicolodi, Rovereto, pp 161–184

[4] Desideri P, De Magistris A, Olmo C, Pogacnik M, Sorace S (2013) La concezione strutturale. Ingegneria e architettura in Italia negli anni cinquanta e sessanta (The structural conception. Engineering and architecture in Italy in the fifties and sixties). Umberto Allemandi & C, Torino

[5] Zevi B (1955) Verso un nuovo Linguaggio (Towards a new language). Architettura Cronache e Storia 4: 381–382

[5] Zevi B (1956) Complessi strutturalisti (Structuralist complexes). Architettura Cronache e Storia 10: 240–241

[7] Salvadori M, Heller R (1964) Le strutture in architettura (Structures in Architecture). Etas Kompass, Milano

[8] Musatti R (1955) Concorso nazionale per la stazione di Napoli (National design competition for the train station of Naples). Architettura Cronache e Storia 1: 2

[9] Nizzoli M (1955) Architettura Cronache e Storia 1: cover picture

[10] Ortelli GC (1955) Opere di Enrico Castiglioni (Works of Enrico Castiglioni). Architettura Cronache e Storia 4: 496–511

[11] Kultermann U (1958) Enrico Castiglioni. Bauen + Whonen 10: appendix IX

[12] Anonymous (1964) Enrico Castiglioni. Biggekunst 3: 58–67

[13] Siegel K (1960) Strukturformen der modernen Architektur (Structure and Form in Modern Architecture). Callwey, München

[14] Kultermann U (1965) Neues Bauen in der Welt (New building in the world). Wasmuth, Tübingen

[15] Pevsner N, Fleming J, Honour H (1967) The Penguin Dictionary of Architecture. Penguin books, London

[16] Reid R (1980) The book of Buildings. A panorama of ancient, medieval, renaissance, and modern structures. McNally & Company, London, p 324

[17] Kultermann U (1979) Enrico Castiglioni. In: 28/78 Architettura. Cinquant'anni di Architettura in Italia 1928-1978 (28/78 Architecture. Fifty years of Architecture in Italy). Domus, Milano, pp 94–107

[18] Castiglioni M (1995) Enrico Castiglioni Architetto (Enrico Castiglioni Architect). Dissertation, Politecnico di Milano

[19] Ottolini G, Perogalli C, Langè S, Castiglioni S, Castiglioni M, Magini G (2000) Enrico Castiglioni. I simboli, I significati di un percorso d'arte tra passato e futuro (Enrico Castiglioni, symbols and the meanings of an art journey between past and future). Famiglia Bustocca, Busto Arsizio, pp 10–29

[20] Giannetti I (2019) Architetture costruite di Enrico Castiglioni nella Scuola Italiana di Ingegneria (Built architectures by Enrico Castiglioni in the Italian School of Engineering). In: Garda E, Mele C, Piantanida P (eds) Colloqui.AT.e. 2019. Ingegno e costruzione nell'epoca della complessità. Forma urbana e individualità architettonica, Politecnico di Torino, Turin, 25-28 September 2019, pp 211–220

[21] Anonymous (1964) Escuela elemental en Italia (Primary School in Italy). Informes de la construcción 163: 23–38

[22] Anonymous (1963) E. Castiglioni, Una scuola a Gorla Minore (Enrico Castiglioni, A school in Gorla Minore). Domus 3: 7–16

[23] Anonymous (1963) Premio Nazionale A.I.T.E.C 1962, selezione della giuria, Enrico Castiglioni (National Award A.I.T.E.C. Jury selction, Enrico Castiglioni). Industria Italiana del cemento 1: 26–31

[24] Pedio R (1960) Opere recenti di Enrico Castiglioni (Recent works of Enrico Castiglioni). Architettura Cronache e Storia 60: 366–386.

[25] Capurso G, Giannetti I (2019) 'Reconstructive re-drawings' and 'reconstructive models' for history of construction. The experience of SIXXI research. Tema: Technology, Engineering, Materials 5 (1): 36–46. doi: doi.org/10.17410/tema.v5i1.213