Research for Development

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Buildings for Education

A Multidisciplinary Overview of The Design of School Buildings

Fondazione Politecnico di Milano

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Preface

This book belongs to a series, which aims at emphasizing the impact of the multidisciplinary approach practiced by ABC Department scientists to face timely challenges in the industry of the built environment. Following the concept that innovation happens as different researches stimulate each other, skills and integrated disciplines are brought together within the department, generating a diversity of theoretical and applied studies.

Therefore, the books present a structured vision of the many possible approaches—within the field of architecture and civil engineering—to the development of researches dealing with the processes of planning, design, construction, management, and transformation of the built environment. Each book contains a selection of essays reporting researches and projects, developed during the last six years within the ABC Department (Architecture, Built Environment, and Construction Engineering) of Politecnico di Milano, concerning a cutting-edge field in the international scenario of the construction sector. The design of schools has been recognized as one of the hottest topics in architectural research, also for the criticalities detected in the current conditions of Italian school buildings.

The papers have been chosen on the basis of their capability to describe the outputs and the potentialities of researches and projects, giving a report on experiences well rooted in the reality and at the same time introducing innovative perspectives for the future.

With the aim of exploring the evolutionary scenario of school design as an architectural topic, the collected papers were selected according to a comprehensive and multidisciplinary overview. Researches on typology and spatial organization are enriched through the contribution of a historical and social perspective to enlarge the focus on the urban role of the school buildings. Moreover, innovative approaches and tools have been highlighted both in the design process and in the education techniques. The presented experiences include best practices of

consistent and coordinated contributions of the several disciplines involved in the design of school buildings, also implementing digital tools. Finally, the issues related to the challenges of the existing built stock triggered the development of more technical and specialized, albeit multidisciplinary, investigations and case studies' reports.

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Introduction

Background

The design of educational spaces dedicated to school is a rather recent topic in Italy, since until the end of the nineteenth century and the unification of the country,[1] children were educated exclusively in private or ecclesiastical environments; and only later, the school education was recognized for its significant role in the teaching and learning processes (Pennisi 2012). The evolution of the architectural school typology and of the primary school in particular, can be analyzed as a complex combination of political, cultural, social and urban planning issues and as a reflection of the historical situation. Through the analysis of the educational buildings erected in the different periods, it is possible in fact to detect the evolution of the legislative framework, aimed at defining hygienic and comfort requirements, and of the organization of spaces required by the different pedagogical approaches. The study of the architecture of existing schools reveals a sequence of construction systems, both traditional and innovative, from masonry walls to reinforced concrete frames and to prefabricated solutions, which were employed to better respond to changing needs (in particular, low construction and maintenance cost and construction time reduction). Finally, and with a strict connection with the above considerations, the role of the school building in the city is remarkable at the urban level also, for its ability to promote the development of entire neighborhoods of a city or for the ability to revitalize an existing portion of a city in relation to other public services and open spaces.

[1]The compulsory education was introduced in Italy with the Casati Law, issued by the Minister of Public Education Gabrio Casati in 1860. This law entrusted the central government the obligation to enact laws in relation to school education and the management of public schools and gave private individuals the possibility of founding and managing institutions, but without the right to confer educational qualifications. In this period, elementary education became free, compulsory only for the first two out of four years (i.e., for pupils aged 6–7 years) but only present in cities with over 4000 inhabitants or in secondary education institutions (Laurenti and Dal Passo 2018).

The Current Situation

The results of a more than a centenary process of school buildings' construction are significant from a quantitative point of view. The whole stock of educational buildings of all levels and dimensions amounts to 42,408 units, hosting 7,816,408 students in 370,597 classes (Miur 2017), distributed all over the national territory (see Fig. 1). However, this is an extremely heterogeneous heritage,[2] because of the aging, the functional and often physical obsolescence, which ultimately does not respond to the current demands in terms of teaching and learning methodologies, but also because of the low comfort and safety performances and of fruition and accessibility problems (lack of compliance with "Universal Design" goals).

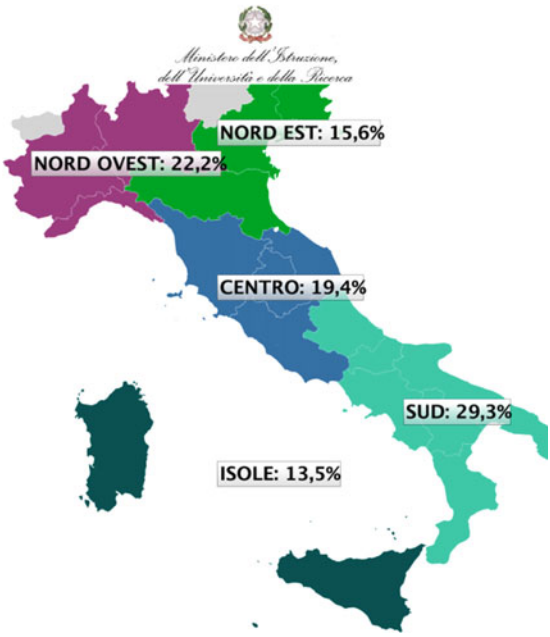

Fig. 1 Distribution of the educational buildings on the Italian territory (Source: MIUR—*Portale unico dei dati della scuola, Anagrafe scuola*)

[2] Thirty-two percent of the schools was built after 1976, 27% between 1961 and 1975, 12% between 1946 and 1960, 8% between 1921 and 1945, 4% between 1900 and 1920, 3% in the nineteenth century, and 1% before 1800. There is no information for the remaining 13% (Miur 2017).

In addition to the hydrogeological hazard that can affect some schools positioned in risk areas, one of the most urgent issues is related to the high seismic vulnerability characterizing most of the existing schools, which indeed were designed with respect to gravity loading only.

The identification of the seismic areas in Italy started at the beginning of the twentieth century, through the instrument of the royal decree, issued after the destructive earthquakes of Reggio Calabria and Messina on December 28, 1908. Since 1927, the areas hit by earthquakes have been divided into two categories, in relation to their degree of seismicity and their geological constitution. Therefore, the seismic map in Italy was nothing but the map of the territories affected by the strong earthquakes after 1908, while all the territories struck before that date (most of the seismic areas of Italy) were not classified as seismic and, consequently, there was no obligation to build in compliance with anti-seismic regulations. Only in 1974, through the law of February 2, 1974, n. 64, a new national seismic regulation was established which defined the reference framework for the seismic classification methods of the entire national territory, as well as for the drafting of technical standards. Immediately after the earthquake of October 31, 2002, that hit the territories on the border between Molise and Puglia, the Civil Protection adopted the ordinance of March 20, 2003, n. 3274, in order to provide an immediate response to the need to update the seismic classification and seismic regulations. According to the ordinance n. 3274, and unlike the provisions of the previous regulations, the entire national territory was classified as seismic and divided into four zones, characterized by different seismic hazard.

This brief history demonstrates that seismic regulations in Italy are quite recent. Indeed, according to the new registry launched by the Ministry of Education University and Research (Miur 2017), only 8% of the schools was designed in compliance with seismic regulations, 54% is in a vulnerable zone, and around 19,000 buildings are situated in high-risk seismic areas. The collapse of educational buildings in the 2009 and 2016 earthquakes in central Italy and the tragedy of San Giuliano di Puglia (2002), where 27 children died in the primary school building collapse, represent a clear symbol of the gravity of this problem.

A second major issue is related to the inadequate energy performance of the educational buildings, again due to the old construction date and to the evolution of the regulations on the energy performance of the buildings, the first being enacted only in 1976, but with very low requirements in comparison with the current situation. Although the European Energy Performance of Buildings Directive (EPBD) requires that "*the public sector in each Member State should lead the way in the field of energy performance of buildings*" and "*buildings occupied by public authorities and buildings frequently visited by the public should set an example*," almost 85% of the school buildings in Italy belongs to the bottom classes of the energy performance ranking. Only 5% (Legambiente 2018) of the stock can be classified among the first three classes, a percentage corresponding to the constructions completed after the 2001, when the first regulations requiring a high standard of energy efficiency were enacted. Hence, if the lack of sufficient structural safety can appear as a real threat, the inadequate energy performance is certainly a

waste of resources and a lost chance as well. Energy retrofit programs in fact can become lighthouse projects not only because schools are public buildings visited by pupils, their parents, and the staff, but also because the direct understanding of the behavior of the building envelope and technical systems can help children learn how to support energy savings as responsible users and transfer the knowledge to their families. A further issue to add to the serious situation of the national heritage, related to both structural safety and energy poor performance, is the significant gap between northern and southern regions; an imbalance which characterizes also the funding for ordinary repairs, let aside renovation interventions.

Furthermore, health and indoor comfort requirements should be addressed, especially when considering that almost 10% (Legambiente 2018) of the existing complexes should be cleaned from asbestos.

Finally, the shift toward a knowledge society where information and knowledge are expanding in quantity and accessibility is introducing major changes in teaching and learning models. The information revolution has changed the way we interact with people and things. We live in a society where information is spread out in a large-scale dimension, and new technologies become new tools to change the relationship between time and space. Learning happens everywhere. The new generation of net-native pupils, with an increasingly different set of expectations about space and time, will require constant access to learning materials and resources to share within and beyond the school. Inter-disciplinary learning and collaborative peer-to-peer learning will become increasingly common. New educational models and approaches will be required to help multiple generations, belonging to diversified cultures and in different fields. This will require a general rethinking of the school layouts to overcome the actual strict zoning of the functions and to respond with a higher flexibility to the rapidly changing demand.

The barriers toward the starting of a concrete policy for the renovation or the replacement of the existing stock are varied. It is not just a problem of economic resources but also of a complex set of different issues related to both the diversity of the heritage and the heterogeneous set of institutions responsible for the construction/renovation process. The schools in fact are managed by municipalities as well as by provinces and also directly by the central state. The interventions, considering the major presence of public buildings, are very often subjected to the national public works legislation, requiring a significant effort in planning and organization. One of the challenges is thus how to support municipalities or institutions, especially the smallest ones, in the process from the design activity, to the tendering, to the site inspections and co-ordination during execution, until the final acceptance testing.

The decision for the construction or the retrofit of the school building should consider the relationship with the urban context and the possible potentials that the public building and its annexes can add to the community, for example, in terms of quality of the public spaces, additional resilience in case of emergency[3] and of lifelong learning[4] or integration with other public facilities. A new construction or a requalification can also trigger the regeneration of the surrounding neighborhoods.

The Challenge of Renovation and New Buildings Design

From 2014, in Italy a vast program[5] of construction of new schools and requalification of existing educational buildings that affect, in different ways, every level of education, from primary schools to universities, have been public financed. Different architectural design competitions were also proposed, beyond the attribution of the design task, to collect innovative proposals able to explore new solutions and approaches for the renovation of the educational facilities. Many examples and competition applications are collected in this book.

This program concerned the transformation of educational and pedagogical approaches, aimed at improving the effectiveness of learning models, as well as the requalification of the existing buildings from an energy-saving and structural safety point of view, the latter with particular regard to seismic vulnerability of the existing buildings.

These themes have long been a field of great interest, experimentation, and research, aimed at developing projects, models, and intervention strategies where different disciplines and skills are involved. The possibility of giving old places a new identity, to update buildings according to the new educational and teaching models, to develop projects that take into account the actual needs of energy savings and structural safety is deeply investigated in the following chapters.

On a broader scale, all these needs offer the possibility of redesigning complex existing buildings and developing projects that play an important role also at the urban level, by becoming reference places, opportunities for redevelopment of degraded parts of a city, new cultural, and civic centers.

This book describes the results of some of the research and consulting works, carried out at the Department of Architecture, Built Environment and Construction engineering (Politecnico di Milano), related to the design of new schools and to the

[3] A structural safe school building in seismic areas can be used, for example, as a possible emergency center or temporary accommodation in case of necessity.

[4] The often-unused spaces of a school building during the evening or weekends can host courses for adults or other continuous learning programs or different activities for the whole community.

[5] Of the ten billion euros invested, five have been spent by municipalities, provinces, and metropolitan cities to construct 300 new buildings and start 12,000 renovation projects. ItaliaSicura, the Council of Ministers authority created to lead and manage the renovation programme, was closed in July 2018 (https://www.corriere.it/scuola/primaria/18_luglio_05/edilizia-scolastica-ambiente-governo-chiude-italiasicura-adef7264-8017-11e8-841c-47290107a48c.shtml).

requalification of existing ones. The description of these activities has been organized into three sections, where particular emphasis is given to the effective collaboration with institutions at various levels and the synergetic combination of the different disciplines involved, needed to respond to their requests through applied and basic theoretical research works.

The chapters, organized into the three different sections, investigate central themes about the buildings for education, focusing, in particular, on the definition of multidisciplinary approaches for the design of new schools and for the upgrading of existing ones. Among the main topics highlighted, the first section focuses on the relationship between the city and the school as a civic building with a public role for the community also to possibly host different functions. Accordingly, some recent concept designs are featured, carried out within national and international competitions, and analytical and historical studies on the theme of schools and on their typology, as well as on the role of these buildings at the urban level, are reported. In the second section, innovative solutions for both the design and the construction process are analyzed, and in some applications, particular relevance is given to the building information modeling (BIM) strategy as an optimal tool to achieve a synergetic combination of the different disciplines involved. Finally, the third section focuses on the built heritage, particularly: (i) on the tools, technologies, and approaches required to upgrade the existing buildings, in order to comply with the new regulations (in terms of seismic resistance and energy performance); (ii) on the possible transformation of unused constructions into buildings for education, and (iii) on the management of the existing stock. Theoretical as well as applied research paths are reported to illustrate the topic both from the methodological point of view and through real case studies.

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Contents

Camillo Boito's "Capannone" for the Accademia di Brera in Milan: Reuse of a Railway Depot

Gabriella Guarisco, Maurizio Acito, Stefano Cusatelli and Mehrnaz Rajabi

Abstract The work concerns the project for the transfer of some departments of the Brera Academy to the area of Scalo Farini located in the centre of Milan. The area is central to the transformations of Milan, and the relocation of the departments of the Academy solves the problem of its development as a school. The transfer occupies the large post office warehouse in the centre of the area, which is the subject of a conservation and evaluation process for the insertion of the new functions.

Keywords Reuse · Preservation · Railway · Depot · Academy of arts

In the heart of Milan, a stone's throw from the Monumental Cemetery, still today we find the physical existence of the two long "wings with a saw-toothed perimeter line" of the former goods depot that unambiguously draw attention to the imprint left by the decommissioned Farini marshalling yard on the city's historical fabric. The building, revamped several times, especially at the end where the subsequent additions are instantly decipherable, constitutes the last physical witness of the history of the transformations that occurred due to the changing routes of the railway system (Aa 1933; Guarisco 2015; Guarisco et al. 2017).

After the early nineteenth-century, in rail transport routes run by private individuals and prevalently for use by travellers, with the establishment of the state railway company, the Ferrovie dello Stato (1 July 1905, Giolitti government), and under the management of the Ministry of Public Works, came the first reorganization of the entire rail network in Milan, and in particular, the fundamental reorganization of the marshalling yard (Rigato 2017–2018). On p. 87: "To expedite the running of the trains, especially in the major stations, it adopted the separation and specialization of transport in passenger and goods, while previously such specialization had never been put into effect" and its buildings. The Central Station became significant and was repositioned towards the edge of the city, while the stations of Lambrate and

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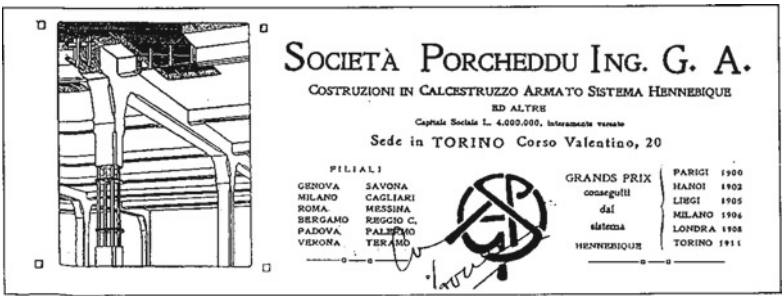

Fig. 1 Example of the characteristics of the "Hennebique system" structures in a logo for postal envelopes of the Porcheddu company

Porta Vittoria were being built. The points of interchange for goods in use up to that point, in addition to the large Sempione yard (1883–1884), were located near the city gates: Genova (1868–1870), Garibaldi (1873) and Rome (1896). The state railways, as part of a sweeping plan to reorganize the entire railway network of Milan, created the Farini marshalling yard (a transfer of the by-then insufficient one of Garibaldi) and that of Porta Romana (as a result of the decommissioning of Sempione, 1931), and the yards near the railway stations of Porta Vittoria and Porta Genova.

The Farini marshalling yard maintains its original north-west alignment, remaining today among the trajectories of greater accessibility to the centre of Milan. Destined to grow exponentially from the date of its construction, it lies at a crucial point of the city, in the immediate vicinity of one of the historical gates and the passenger station of Porta Garibaldi. Over the last 20 years, the physical aspect of the entire area has changed profoundly: large swathes have been razed, the towers of the Bosco Verticale—"the Vertical Forest"—have risen, Piazza Gae Aulenti was fashioned with new buildings surrounding it that generate a skyline of corporate towers very similar to those of metropolises around the world. Beyond this area, the old marshalling yard has remained (now covering an area of 618,733 m^2) which, in its growth, has extended as far as the Monumental Cemetery (Figs. 1 and 2).

With the *Marshalling Yards Program Agreement* (2017, but the planning process for the abandoned areas had already begun in 2005), it was stipulated *inter alia* that "the marshalling yards […] can accommodate cultural activities, even of a private nature, tied to music, art, and architecture, by developing the existing buildings wherever possible" (point L, p. 27) with the launch of procedures to regenerate the abandoned areas. It was within this framework that the *Steering Document*[1] appeared,

[1]On 22 December 2017, a letter of intent was signed between the Municipality, FS-Sistemi urbani and the Accademia di Brera, and thereafter (3 May 2018), a more specific convention for the use of part of the large former goods depot as new premises for teaching activities as an expansion of the Academy's historical seat. In the follow-up to research already begun some years earlier (Monica L., Scarrocchia S. 2015), the Academy charged the Polytechnic University of Milan (Head Monica L., consultants Guarisco G., Nastri A. and Acito M.) to prepare a Steering Document that could lay the foundations for the subsequent project phases. On 27 February 2019, in the presence of

Fig. 2 A view of the inside of the depots today

produced in November 2018 with verification of the feasibility to reuse the former depots for some educational and workshop activities of the Accademia di Brera.

Despite relentless consultation of the accessible archives and research on bibliographical bases, up till now it has proved impossible to establish the exact date of construction of the former depots (1910–1914?), even though the research has produced an advancement of knowledge in this regard.

After the state took over the national railway network, the executive committee of the municipality set up a new commission presided over by the Rector of the Polytechnic (the engineer Giuseppe Colombo) which drafted a definitive development plan adopted immediately by the railways. It was in the plan of the municipal engineers Pavia-Masera (1909–1912) that the structure of the Farini marshalling yard, a "new low-speed freight yard" appeared for the first time in all its grandness (Cusatelli 2019). Its mixtilinear profile combines a curve in the northern part (to delimit increases in the number of rails) with a straight line parallel to the tracks which arrives almost as far as the Bovisa gasworks. The works to construct the yard proceeded rapidly: the two wings of the general depots appeared for the first time in the IGM map of 1914 (Figs. 3 and 4).

If the materials available at the Milano-Greco railway (Ministero delle Comunicazioni n.d.; Canella 2010; 6 table Archive of the FF.SS.) archives do not for the moment allow confirmation of the date when the works were completed, the

the authorities, the ceremony to inaugurate the Accademia's academic year took place inside the marshalling yard, in an area made safe especially for the occasion.

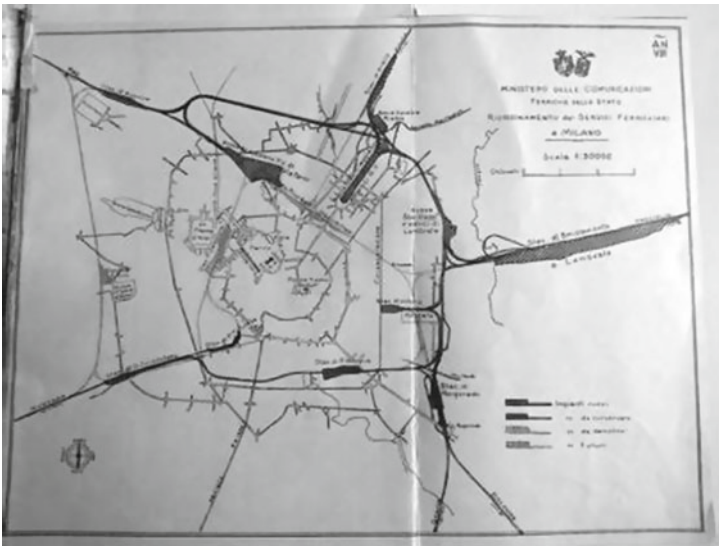

Fig. 3 Ministry of Communications—Ferrovie dello Stato, Riordinamento dei servizi ferroviari a Milano, General Plan (n.d.), Raccolta Bertarelli Milan

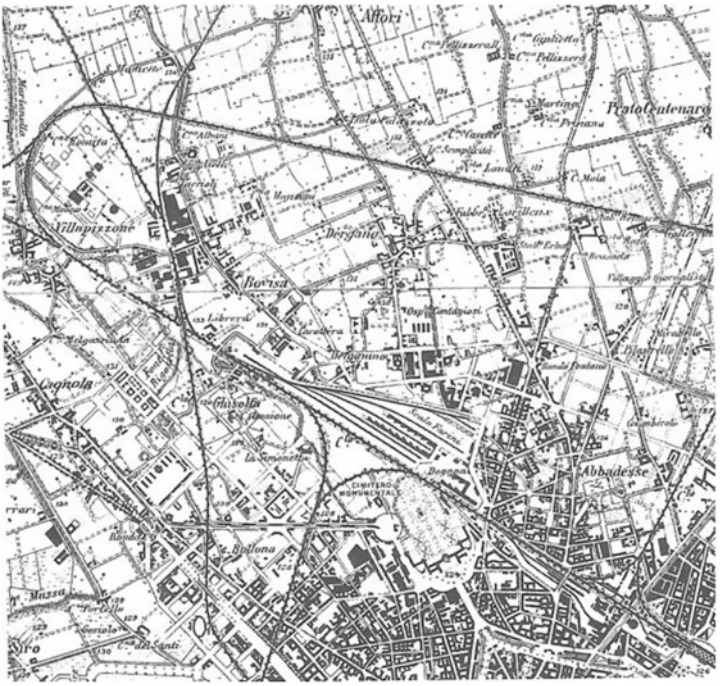

Fig. 4 Istituto Geografico Militare, Panel Bollate and Milan West, 1914, IGM Archive

newspaper *Corriere della Sera* reported the inauguration of the marshalling yard not long after WWI (16 September 1921). The journalist described the depots thus as: "Enormous and ready to accept an upper story that is already likely and for which everything has already been arranged, these depots cover an area of 22,000 m^2, without counting the 6,000 m^2 of open-air loading bays, and are constructed with a saw-toothed perimeter line to make loading and unloading easier on the intermediate and external groups of rails", since the declaration that they were already in use, with every probability, they were constructed at the time of the Great War and "could be relied upon to accommodate many soldiers and machinery" (Elia et al. 2015).[2] Later on, the depots appeared in operation in the photographs of a volume that celebrated the conclusion of the works on the Central Station[3] (1934) (La Stazione Centrale di Milano 1931).

The two long wings are typologically related to industrial sheds and so today can justifiably be considered of interest to industrial archaeology. From the outside they appear as a repeating series of walls with large openings arranged above a high "plinth" (to permit the passage of goods at a height) surmounted by the indispensable canopies, installed (in different periods) to avoid the work being hampered by bad weather. The spaces are equally repetitive inside, rhythmically broken up by the "forest" of pillars surmounted by beams in reinforced concrete. In this respect, it should be noted that this construction system, which has seen widespread use in large buildings that had to be erected quickly, is related to the so-called "*beton armé Système Hennebique*" (Riccardo and Signorelli 1990).

The dissemination and evolution of reinforced concrete techniques in Italy with reference to the Hennebique System, introduced by G.A. Porcheddu, agent and general licensee for north Italy,[4] took place in the years between the end of the nineteenth century and the first decades of the twentieth century. Among the first uses of this technique in Milan, albeit limited to horizontal structures (decking), was the realization (1897–1901, 1898 contract) of the building for the Società Assicurazioni Generali Venezia, which still exists today in Piazza Cordusio and was designed by the architect Luca Beltrami in collaboration with the engineer Luigi Tenenti. This building, with its traditional wall structure, sees the use of floors (originally envisaged as beams and vaulting) made from reinforced concrete according to two structural typologies: the first consisting of slabs with main and secondary ribs (to be used for the upper storeys) for smaller ceilings; the second consisting of flat intrados which required a double slab to be used for the larger ceilings to cover the halls on the ground floor (Figs. 5, 6 and 7).

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[2] See: Elia M.M., Cantamessa L., Petrucci E. (2015). "Fortunately, the Italian State Railways in the previous two years the war, had begun work to develop the 'strategic' lines and installations with some interventions that dated back as far as 1908 when, as a result of the burgeoning fears of a possible attack by Austria upon expiry of the Triple Alliance, the FS decided of its own accord to scale up the marshalling yard at Mestre".

[3] La Stazione Centrale di Milano—Inaugurata l'anno IX E.F., official illustrated supplement authorized by the Ministry of Communications, Milan 1931, p. 58.

[4] The Porcheddu company's clients included the state railways.

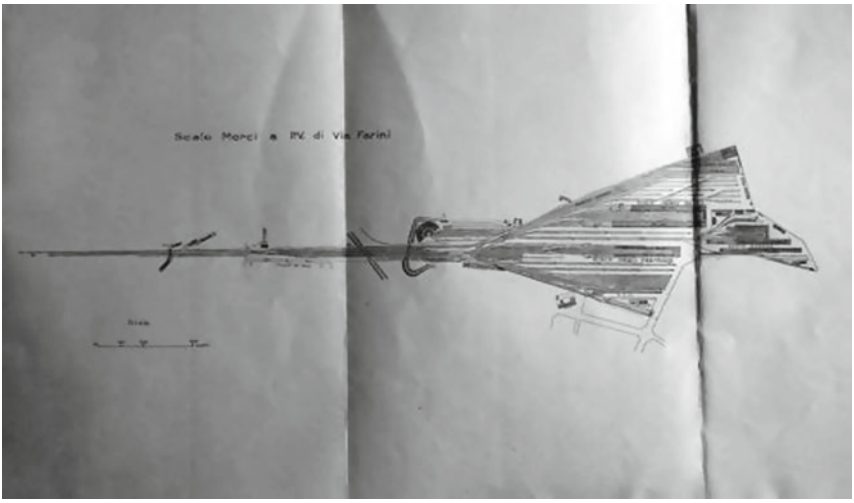

Fig. 5 Ministry of Communications—Ferrovie dello Stato, Farini Railway yard, Project plan, undated, Raccolta Bertarelli Milan

Fig. 6 *Original view of the Warehouse building, undated,* (La Stazione Centrale di Milano 1931)

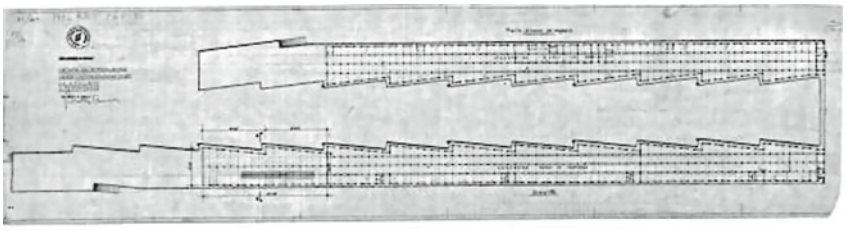

Fig. 7 State Railways Project Office, Plan of the Warehouse building, undated, FF.SS. Archive Milan

Again in Milan, one of the first and most important examples of a structure realized in reinforced concrete with large ceilings is the *Grande Salone*—the Great Hall—(built in 1900) in the courtyard of the Brera building. Measuring 15 × 25 m, it was intended for a classroom that had to temporarily accept works of sculpture submitted for the 1900 Brera Exhibition (Il nuovo grande salone di Brera 1900). The work was designed and completed by the architect Augusto Brusconi[5] of the Regional Technical Office for the Conservation of Monuments.

Despite Hennebique's patent expiring in 1903, the structures of the depots are practically a plastic recreation of the structure represented in the A.G. Porcheddu company logo with which they advertised the Hennebique system, as proof of the strong monopoly that the company had acquired as a patent licensee. In fact, comparing the image of the company logo with an image of the depot structures, we can recognize in both the classic typology of pillars, beams and slabs in reinforced concrete used for industrial buildings, as an evolution that saw for this type of building the passage from constructions of a nineteenth-century type (several aisles with perimeter walls in brick and structures generally in iron) to buildings that adopted reinforced concrete for the horizontal structures (possibly with reinforced concrete pillars in the inner zones) but with façades still in masonry.

The structural elements which were also part of the new architectural language and that characterized the industrial building were the pillar, with characteristic rounded corners, of a generally reduced size (40 × 40 cm, 50 × 50 cm); the main beams depressed by the ceiling slab, with chamfered corners and connected to the pillars via corbels; the secondary beams to stiffen the slabs and fit into the main beams; slabs of reduced thickness and dimensions which could be rectangular or square. Clearly, compared to the previous examples mentioned, in the case of the structures of the two wings, we are in the presence of a further evolution of this type, which also saw industrial buildings freed from load-bearing perimeter walls, almost certainly due to the need to have large openings around the perimeter to facilitate the movement of goods.

Another consideration must be made regarding the use of the Hennebique system by the two Milanese designers Beltrami and Brusconi, the authors of several restoration works, as a matter of common knowledge. The Office (established in 1892 but in operation from 1893 until 1908 when the Superintendencies were set up), is located at the Brera, where two other institutional seats coexist: the administration of the homonymous picture gallery (Corrado Ricci) and the administration of the academy (Camillo Boito). From an examination of the Corrado Ricci archive (Guarisco 1995), a series of private letters to Boito came to light (September 1912) from which it emerges the opinion of both on the members of the Regional Technical Office. Ricci, who was preparing the First Conference of Honorary Inspectors and Superintendents (which took place in Rome in 1912), sought Boito's approval and support for the initiative. But Boito, who saw in the conference the enactment of a

[5] Among other things, the architect Augusto Brusconi would be the leading light of the project "for the general organization of higher education institutes" in Milan, and later on, in the establishment of the new Polytechnic seat of Città Studi.

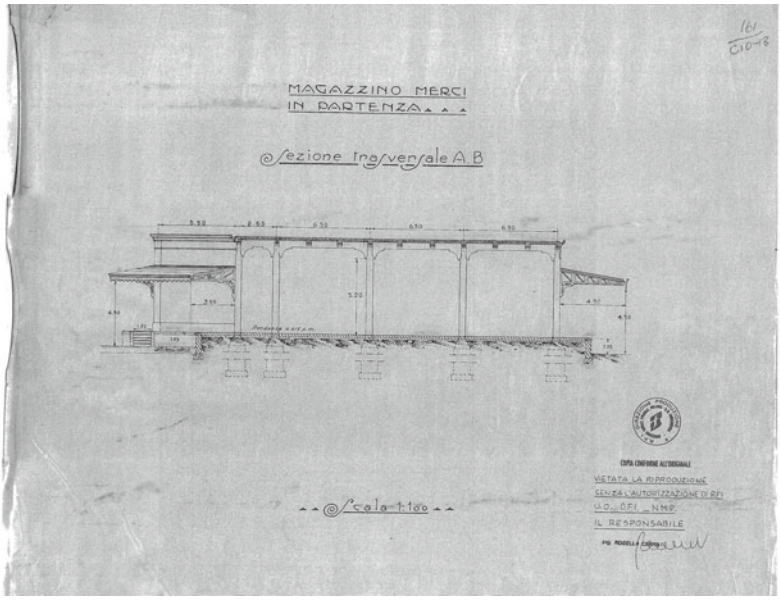

Fig. 8 State Railways Project Office, Cross section, (n.d.), FF.SS. Archive, Milan

"pompous little school" which he considered "unseemly", obliged Ricci to make a pungent and ironic defense through which in the end he would has obtained Boito's blessing. The question would seem of no interest, unless for the fact that Ricci, to bring Boito over to his side, attacked in no uncertain terms first the representatives of the Technical Office and then Boito himself.[6] In short, the atmosphere was not exactly placid. Of course, Boito, in 1912 (he died in 1914), must have already seen (if not directly commissioned?) the project, and the execution of Brusconi's works in the courtyard of the Brera for the construction of that building which already used the Hennebique system, and was supposed to host the 1900 exhibition, and then the *Gipsoteca*—plaster cast gallery—too inconsequential within the picture gallery (which Ricci directed from 1898 to 1903) (Figs. 8 and 9).[7]

At this point, and with this reference framework, also the now famous phrase of Boito becomes clear: "Oh this blessed shed! It would be our anchor of salvation for the Academy and for the exhibition [that of 1900], it would put everything in place for the teachers and the pupils and the artists: I dream of nothing else than the shed,"[8] and

[6]See: Guarisco G. (1995). Ricci to Boito, 27 September 1912: "From the walls of the Palazzo di Brera exude a kind of poisonous humidity that attacks the mood. Beltrami, Brusconi, Moretti, and Modigliani have all come and been touched by it […]. Reading your ferocious penultimate letter, I said: Sadly, even Boito has become Beltramiated, Brusconiated, Morettatied, and Modiglianiated." The correspondence is kept in the C. Ricci Collection at the Classense Library of Ravenna, under nos. 4010, 4011, 4012, 4013.

[7]See: Pini (2009–2010).

[8]C. Ricci Collection, Correspondence, no. 4041.

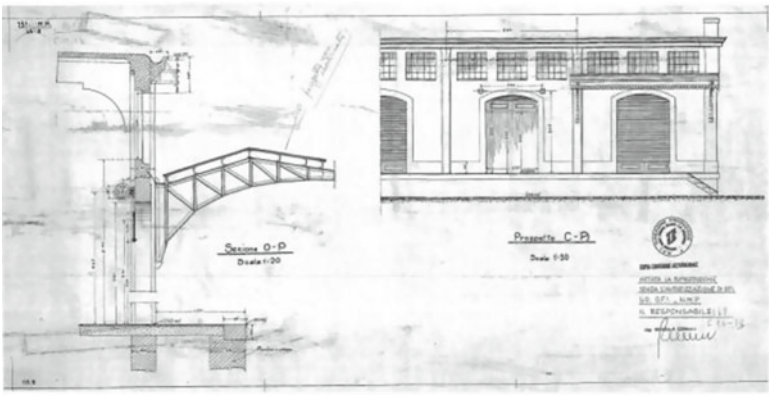

Fig. 9 State Railways Project Office, Front and section (n.d.), FF.SS. Archive, Milan

thus the assumption (which only further extensive research can confirm) that Boito was well aware of the Hennebique system (and this is not something extraordinary, seeing that Brusconi was building it before his eyes) seems evident, but also its use for the construction of large buildings, such as the "shed" referred to. From here to say that the shed wanted by Boito for the academy and its teachings were the Grande Salone or the former Farini depot is still somewhat impulsive since the research does not offer any concrete proof, either regarding the designers or the dates.

It should now be acknowledged that this hypothesis is the result of a close collaboration between contiguous disciplinary areas (restoration, architectural design and structural engineering) that have difficulties seeing eye to eye, but which—when they do—produce unexpected results on the research front.

The first fact-finding investigation of the former Farini depots produced a long series of not negligible particulars in the planning phase to verify the impact for reuse as the seat for some lessons of the Accademia di Brera. Owing to the importance of some of the protagonists of Milanese cultural history in the nineteenth century when it comes to architecture and monuments (Boito, Beltrami, Brusconi, etc.) and due to the importance of the Hennebique construction system used here in a precocious and singular manner, it was already frankly stated in the *Steering Document* that only interventions aiming at the practical conservation of the edifice as it has come down to us would be eligible.

In order to proceed in accordance with the rules laid down in the *Cultural Heritage Code* (2004), an initial phase of cultural valorization would be followed by a physical valorization by reusing the extant remains It is not only to honour Boito's work and that first Restoration Charter (1883) that the conservation of the existing building will be carried out. It is a homage to a school, the Politecnico di Milano (where Boito himself promoted the teaching of restoration much sooner than in the rest of the Country), the continuity of working relationships with the Accademia di Brera (renewed in these studies) and, ultimately, the joint search in the former depots for spaces suitable to teaching activities that are which in both institutions of top quality.

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