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"Società Nazionale Officine Di Savigliano": The History Through Case Studies

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Abstract: Società Nazionale Officine di Savigliano was a company specialized in railway constructions, metallic bridges and mechanical and electrical constructions. Between the end of the 19th century and the beginning of the 20th century, the company became well known in Europe especially for metallic constructions, having built the majority of metal bridges in the north of Italy such as the famous Paderno bridge (1887-1889), one of the biggest arch bridge for the period. In the 1930s, the company built some interesting examples of steel frame buildings, applying the electrical welding technique, acquired in industrial constructions, to civil buildings. The steel frame was quite rare in Italian buildings, especially in the matter of civil constructions and Savigliano made an effort in modernizing the Italian construction system, through research and innovation. The paper will discuss some examples of Savigliano's works dating back to 1930, and in particular, it will present a specific example never studied before: the hangar at the Elmas military airport, in Cagliari (Sardinia). The building is worth mentioning for the innovations experimented, as the new welding technique allowed a series of improvements in the construction process.

Key words: History of the building trades, metallic construction, electrical welding, building techniques.

1. Introduction

The "Società Nazionale Officine di Savigliano" (national company workshop Savigliano) was founded in 1880 taking over the activity of a previous company, established for the construction of the railway track Torino—Savigliano. The firm specialized in railway construction, metallic bridges and mechanical and electrical constructions. In 1889, a new Savigliano headquarter in Turin started the production, specializing in the electromechanical field, while Savigliano specialized in railway construction.

At the end of the 19th century, Savigliano expanded its production in the field of metallic construction, gaining international renown especially for the construction of bridges, having realized many interesting examples, especially in the north of Italy. The most known is the Paderno d'Adda bridge, which was a remarkable arch structure for the period with its 150 m of span and 37.5 of vertical rise.[1]

During the fascist regime, the companywas affected by the new political situation both positively and negatively. Certainly, the repression towards the labor unrest, conducted by the government, met the company's management satisfaction but, at the same time, the lira revaluation was a problem for a company with a strong export connotation. What is more, the compulsory choice of national products produced the increase in raw materials prices. After a period of crisis, due to the critical economic situation, at the end of the 1920s, the company succeeded in improving its condition thanks to export and to the war in Ethiopia that determined an increase in the number of orders. In particular, the product expansion regarded the fields of the metal carpentry, conduits,

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[1] It was designed by the Swiss engineer Jules Röthlisberger, head of Savigliano technical office, and it probably represents the first large construction designed following the "Theory of the Ellipse of Elasticity".

holding tanks, electric locomotives and military products [2]. The situation was quite complex, as to the orders increase corresponded the shortage of labor, due to the war, as well as the difficulty in finding the necessary supplies because of the trade sanctions against Italy. On the one hand, the "autocracy" promoted the national production; on the other hand, it caused the high prices of raw materials, situation readily reported in the Bulletin pages [2] [9]. Nevertheless, the rising gains starting from the middle of the thirties[3] prove the growth of the company [2].

2. The 1930s: Research and Experimentations

Despite the critical situation during the 1920s and the 1930s, Savigliano succeeded in expanding further its production, already diversified, enhancing innovation and research.

Until now, the research conducted regarding SNOS[4] focused in particular on the analysis of labor dynamics and on economic and business issues. The studies concerning construction subjects dealt with the first period of the activity and therefore pertain principally infrastructures. However, a very interesting aspect to consider about Savigliano is the research and experimentation aptitude shown during the thirties.

In fact, especially starting from the 1930s, the company embraced the field of steel frame building, applying the technic innovations, obtained in the industrial constructions, to civil buildings. In particular, Savigliano was the first company in Italy to introduce the electrical welding, experimenting the new technique first in secondary part and then in bigger structures such as three electric locomotives for the track Aosta—Prè S. Didier and an extended roofing for its own workshop in Turin [3]. The fast progress of the technique allowed the construction in Turin of the two most famous Savigliano buildings: the headquarter of the Reale Mutua Assicurazioni (1930-1936) and the "Torre Littoria" (1933), both realized for the same insurance company and designed by A. Melis and G. Bernocco. These two buildings represent the first application in Italy of electrical welding in civil constructions.

During the 1930s, Savigliano committed itself to spreading the use of steel in Italian constructions through the publication of its technical bulletin, in which the company presented all the technological achievements, the ongoing works, as well as the most important constructions described in detail. The attempt to modernize Italian construction system was also at the purpose of the 1933 "Triennale di Milano". Specifically, the exhibition dedicated to modern houses, with Pagano as artistic director, was the perfect occasion to show how steel could be a practical, economical and innovative solution for modern housing needs. Four steel houses were built, three of which with the explicit purpose of showing the potentiality of the "new" material [21].

2.1 "Casa a Struttura di Acciaio" at the 1933 Triennale

Particularly, the "Casa a struttura di acciaio" (house with a steel structure) was designed with the specific intent of promoting the advantages of steel in civil construction and the first two floors were left deliberately uncompleted in order to show the structural frame (fig. 1). The national fascist association of Italian metallurgic industries promoted the project, assigning the design to Pagano, in collaboration with Albini, Camus, Palanti, Mazzoleni and Minoletti. However, the structural project was Pagano and Camus responsibility, with the Savigliano technical support. The company concluded the assembly work in 28 days, using the welding system named "Arcos" [4]. The edifice was devised to be part of an ensemble of aligned seven-story buildings but,

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[2] Starting from 1926 Savigliano published the "Bollettino Tecnico Savigliano" (Savigliano technical bulletin) in order to promote the company activity.
[3] The value of a share passed from 30 lire in 1935 to 48 in 1940.
[4] Società Nazionale Officine di Savigliano.

as demonstration for the Triennale, they built just one element consisting of four stories, with an only apartment completely finished. The typical flat was 8.05 × 25.5 m and it was divided in six bays along the length, following the regular distance between the columns. The building frame consisted of NP30, NP24 and NP26 profiles combined together to form the columns. The girders were IPE 135 and, thanks to spacers between the NP30s forming the column, they were arranged to pass through the profiles, without interrupting their continuity [14]. Secondary beams were chosen to be lightweight and resistant at the same time, so they adopted "Bates" trusses 30 cm high, which allowed the formation of an air chamber between the main beams [4].

Such a prototype of modern living needed certainly the flexibility as requirement, so the flat organization was design to be easily adaptable, having the possibility to change the rooms number from one to four. Therefore, the windows, regular and made of national iron profiles, were designed with a U-profile between them, in order to easily receive a future new partition. Moreover, to enhance further the living room usability, they removed two columns from the demonstrative flat, replacing them with two metallic cable connected to the main beam. This was also an opportunity to show another application of the steel in architecture: the tensile structure.

2.2 Fiorini's Projects in Collaboration with Savigliano

The engineer-architect Guido Fiorini is a little known figure but his experimentations during 1930s are very interesting. In fact, he elaborated a project of a multi-story building with a tensile structure, grounded on a central nucleus and steel cables, which aroused the interest of Le Corbusier (fig. 2). The stories independence from the structural system allowed the flexibility, in the urban design, searched by the Swiss-French architect and this promoted the collaboration between the two designers. Fiorini, elaborated three different version of the "tall building" thanks to Le Corbusier's suggestions and the version patented in 1932 was adopted for the Algiers Plan B.

But it was thanks to Savigliano project office expertise that Fiorini's invention acquired technical feasibility, as they solved the more challenging technical issues such as the cables joints, foundations, and the structure response to wind load. The long-standing experience of the company in the field of metal frame constructions allowed the structural definition of the project, in every executive detail with a remarkable precision and clarity of the graphic expression, inherited from the mechanic tradition of the company [22]. The collaboration continued with a project of a skyscraper with a welded

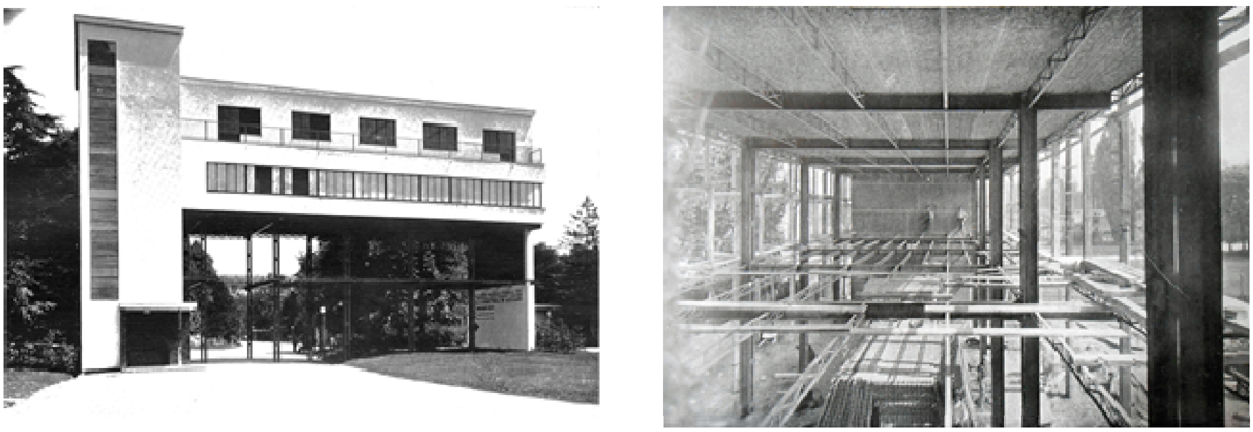

Fig. 1 Casa a struttura d'acciaio, (house with a steel structure) [3, 4].

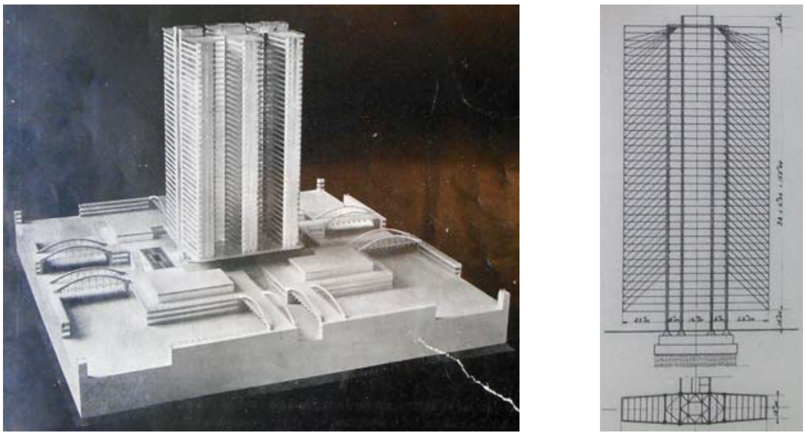

Fig. 2 “Tall building” with a tensile structure (Bollettino Tecnico Savigliano 1934, SNOS Archive).

Fig. 3 Skyscraper with a welded steel frame (Bollettino Tecnico Savigliano 1934).

steel frame, presented in 1934 in the Savigliano technical bulletin (Bollettino Tecnico Savigliano 1934). In this project (fig. 3), Fiorini abandoned temporarily his research about cable-stayed structures in order to emphasize the possibilities offered by the application of electrical welding in civil building construction, supporting Savigliano effort to spread the new technology in Italian construction industry. The collaboration between Fiorini and Savigliano is extraordinary in the 1930s cultural climate, especially in a city such as Turin, where research and innovations were manifestly connected to engineering industry production. On the contrary, “neither Savigliano wants to privilege research exclusively directed toward specific profits, nor Fiorini is led to accept a technical simplification of his intellectual work” [22].

3. Hangars Construction

Hangar construction had a parallel development with the technical progresses in the aviation field. Initially, the first hangars were wood-frame buildings, relatively simple structures built using massive pieces but generally designed as temporary shelters. The arrival of airships determined the necessity of bigger and more complex structures therefore steel and concrete[5] began the most common choice in hangar construction. Starting from the first massive structure dedicated to the airships shelter, the “Hangar Y”, built in 1879 near Paris, this type of construction spread around Europe, especially in Germany where they reached remarkable dimensions and interesting design. In fact, they built the first examples of parabolic arches hangars with hemispherical doors that rotated around a central fulcrum, solution that will be adopted especially in USA [12]. “America lagged behind Europe in aircraft design and aviation facilities, yet the technical and engineering innovations of United States hangar design were of great interest internationally” [8]. It is impossible, in fact, not to mention the Goodyear Airdock (Ohio) built in 1929, with the astonishing measures of 366 × 100 × 64 m, or the similar Hangar One (1932) at the Moffet Field airport, California, both made of a

[5] The Orly hangars designed around the 1920s by the French engineer Eugene Freyssinet are notable examples.

network of parabolic steel girders.

On the other hand, the hangars designed for airplanes, required different features than ones intended to store airships. First, they needed a large opening depending on the wings size and on the number of aircrafts to be stored. This led, in the different countries, to a variety of project solutions, chosen depending on the building techniques, the material features and the structure type. In the 1930s, the aircraft construction techniques constantly improved; therefore, it was necessary to adapt the structures, repeatedly. In the United States, "the typical hangar constructed in the early 1930s was rectangular with a gable roof, distinct corner piers, concrete floor, steel sash windows along the side elevations, and sliding metal doors on overhead tracks at the gabled ends. The general hangar measured 110 ft wide" [1].

However, it was in Europe that research in hangar construction produced the most extraordinary examples, especially as regard to concrete structures.[6] Emblems of concrete construction more than just symbols of hangar design, the 1930s hangars conceived by P. L. Nervi, are famous all over the world. Nonetheless, it is certainly less known the collaboration with Savigliano [6], which led in 1932 to the design of a circular hangar, although it was never built. The structure was composed of 32 cantilevered steel trusses with a cylindrical central pillar made of reinforced concrete and concentric secondary beams. The hangar was designed to be easily accessible from airplanes, therefore it could be completely opened, thanks to sliding doors [12].

Starting from the 1930s, due to a sort of deal with the Aeronautic Ministry, Savigliano designed and built several hangars, the great majority of which with a steel frame[7]. At that time, hangar construction was characterized by a constant research toward standardized models, in order to improve qualities such as easy and rapid assembly and minor bombing exposure [16]. Even Savigliano committed itself to this research, devising many repeatable projects (fig. 4), which were catalogued basing on the dimensions. An example is the project of a very small hangar (26 × 21 × 5.5 m), dated from 1936, planned to be assembled and dismantled very easily and quickly. In fact, the structure was composed of four interchangeable piers and six interchangeable too trusses. What is more, after the assembly conclusion, the elements used for the roofing lifting became part of the structure, thus avoiding the use of specific equipment. Another interesting example is a project for a removable circular hangar with a tensile structure, designed in 1939.

Between the stable hangars, two projects are particularly meaningful because of their technical innovations. One of them, never built, is the Fiorini's hangar for the Linate airport (1933-34) (fig. 5), which was an impressing construction of 200 × 54 × 15 m without interior supports and based on the tensile structure [10, 17]. In this project, as well as the others, the Savigliano expertise was decisive in giving the idea the technical feasibility and a major theoretical completeness [22]. The other interesting project is the Savigliano hangar at the Elmas military airport.

3.1 The Savigliano Hangar at the Elmas Military Airport

The first available project dates back to 1930 but the design process continued until 1933 when the construction was completed in less than seven months (fig. 6).

As well as the valuable architecture, the building is worth mentioning because of the innovations

[6] In April 1930, Architectural Forum dedicated an enthusiastic article about hangar construction in Europe and the author, the engineer E. W. Stern, concluded saying: "I have never seen anything to equal the hangars at Orly, and they are an object lesson to American engineers and architects in the possibilities of reinforced concrete".

[7] The only exception is a project, dated 1939 of a wooden structure hangar, proposed as an alternative solution to the same metallic structure, probably an attempt to save materials with a view to the war necessities.

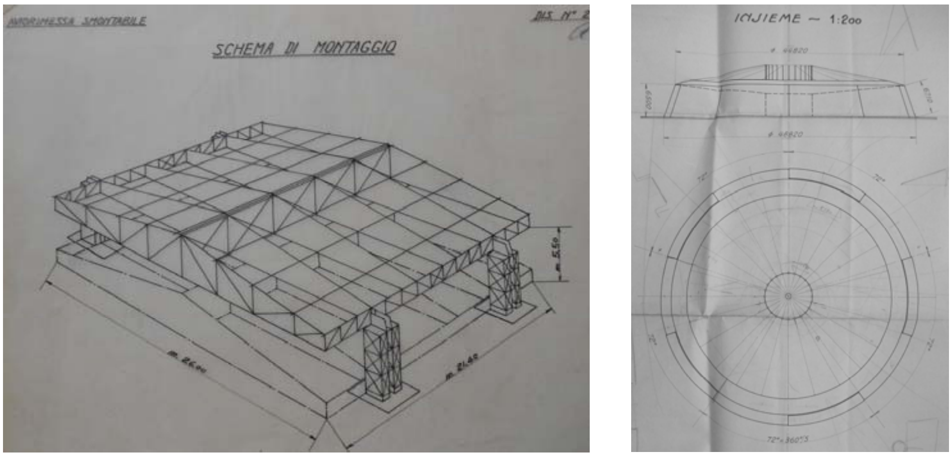

Fig. 4 Removable hangars (SNOS Archive).

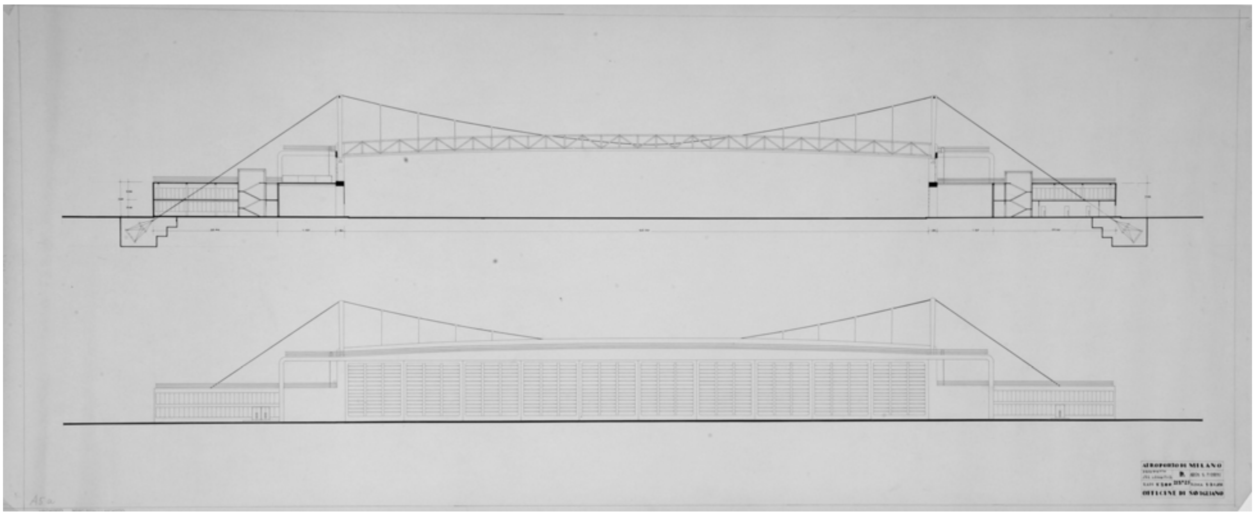

Fig. 5 Fiorini's hangar for the Linate airport (ACS Rome).

experimented. The new welding technique, allowed a series of improvements in the construction process: the reduction of the steel sections because of a best strain distribution; the decrease in the structure weight as a result of the elimination of the joint plates, among other things; the abatement of labor costs; a time-saving due to the faster preparation and transport of the material as well as the quicker assembly. As a consequence, it was possible to build an entirely welded structure of about 135 × 55 × 12.5 m without interior supports, in a short time. The roofing, made of artificial slate, is supported by two main longitudinal trusses, collocated at the main front, and a double truss at the center line, which was also a wind brace. What is more, the particular closing system, composed of eight sliding doors, which are easy to manipulate thanks to rails connected to the load-bearing steel structure, allowed the easy shelter of the aircrafts [11, 17].

At that time, the hangar was mentioned in important architectural reviews, such as "L'architettura Italiana" and "Casabella", but without defining the location or specific details, because of the military secret. It was described as "the biggest metallic construction electrically welded ever assembled in Europe and maybe in the world" [11]. The first electrical welded buildings were constructed in United States, where the application of the technique had a rapid growth [13]. "In France, the first welded civil engineering projects date from 1936: a 40 m road-bridge at Ourscamp in the Oise" [15]. In Germany, the first completely welded construction was concluded in 1930 and was a bridge spanning 10 m [20]. The hangar construction, requiring wide spaces and the absence of interior supports, was a challenging test for the welding technology. In 1928, three hangars, with an arch steel frame, were built for the Houston Texas Municipal Airport using the arc welding. The dimensions of each hangar were 23 × 38 × 15 m [13]. In Germany, the welding technique was applied to two curving hangars (1938) of the Tempelhof airport, but this structure was hidden by some purely decorative elements. In fact, just one in five of the vertical columns actually had a load-bearing function [7, 12]. Another structure, comparable with the Savigliano hangar from a technological point of view, is the Linate hangar (Milan) designed by architect D.

Fig. 6 Savigliano hangar at Elmas military airport (ACS Rome).

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Torres and constructed in 1937-38. The rectangular structure (120 × 60 × 12.5 m) was composed of two main metallic arch beams supported by reinforced concrete columns. Some authors [5, 12] indicated this, as the first hangar in Europe with electrical welded joints.

Probably, the Elmas hangar remained almost completely unknown until now, despite the interesting esthetic and technical features, because of the military function and the consequent secret about its position.

Conclusions

In Italy, the steel building frame follows a sort of parallel development in the field of the modernisation of the construction system, more connected to the research environment, through competitions and experimental projects. The 1930s are particularly meaningful to the history of metallic constructions. In fact, on the one hand it can be traced a lively cultural debate about the steel frame from the pages of journals such as Casabella; on the other hand those are the years of the "autarky", which determined strong limitations to the use of metals in architecture. Although the limited spread of steel structures, the subject is interesting from a technical point of view and with regard to the construction methods innovations, even if many of these projects remained on paper.

It is important to consider Savigliano input in order to retrace this part of the Italian construction history, in part unexplored yet. In fact, Savigliano gave a great contribution to the renewal of the building sector, especially with regard to the construction industry, having introduced some important technological innovations, such as the application of the electrical welding to the metal carpentry. What is more, during the 1930s, the company collaborated with some of the most important Italian architects and engineers of the time, such as Fiorini, for the development of the "tensistruttura" (tensile structure), Nervi for the project of a circular hangar but also Sottsass, Melis and Bernocco, Moretti, De Renzi and Libera.

References

[1] Aaron, J. 2011. "Historical and Architectural Overview of Aircraft Hangars of the Reserves and National Guard Installations from World War I through the Cold War". Department of Defense Legacy Resource Management Program.

[2] Balbo, I. 2006. "La Società Nazionale Officine di Savigliano." In *Storia Di Savigliano-Il '900*. Savigliano: L'Artistica, 189-223 (in Italian)

[3] *Bollettino Tecnico Savigliano*. 1933 n. 3-4; 1934 n. 1

[4] *Casabella*. 1933. "La Casa a Struttura Di Acciaio," n. 68-69. 5–12

[5] Chiaia, V. 1971. *L'acciaio Nelle Costruzioni Moderne.* Bari: Dedalo. (in Italian)

[6] D'Orazio, M. 2008. *Contributi Alla Storia Della Costruzione Metallica: Progetti E Realizzazioni Degli Anni "30 per L'edilizia Abitativa*. 1st ed. Florence, Italy: Alinea. (in Italian)

[7] Drieschner, A. 2005. "Ernst Sagebiel's Temphelof Airport: Typology, Iconography and Politics". In *Historic Airports: Proceedings of the International L'Europe de l'Air Conferences on Aviation Architecture,*

[8] Eggebeen, J. 2007. *Airport Age: Architecture and Modernity in America.* Ann Arbor: ProQuest.

[9] Fasoli, V. 2012. "The National Ironworks of Savigliano on the Mediterranean Rim." *Building beyond the Mediterranean: Studying the Archives of European Businesses (1860-1970),* edited by Piaton, C., Ezio G., and Peyceré, D. Arles : Honoré Clair.

[10] Fiorini, G. 1934. "Ingegnere Guido Fiorini: Progetto di Aeroporto Civile." *Casabella* 12 (80): 310-3. (in Italian)

[11] Leoni, C. 1934. "La Saldatura Elettrica Nella Costruzione Delle Aviorimesse Metalliche." *Rivista Aeronautica* 9 (September): 479-95. (in Italian)

[12] Marchi, M., Marchi, O., and Privileggio, G. 1992. *L'architettura Degli Hangars*. Padova: CLEUP. (in Italian)

[13] McKibben, F. P. 1929. *Evidence That Welding Is Being Adopted for Fabricating Steel Bridges and Buildings.* Boston: General Electric Company.

[14] Morganti, R., and Tosone, A. 2009. "The Steel House in Twentieth-Century Italian Architecture: Experimental Prototypes and Projects at the Milan Triennale Exhibitions, 1933-1954." In *Proceedings of the Third International Congress on Construction History,* 3.

[15] Pescatore, J.-P., and Borgeot, J.-H. 2008. "Welding Steel Structures." In *Metallurgy and Mechanics of Welding,* edited by Blondeau, R. 1st ed. New York: Wiley-ISTE.

[16] Ranisi, M. 1991. *L'architettura Della Regia Aeronautica*. Roma: Stato Maggiore Aeronautica. (in Italian)
[17] National Archive Turin. Year. SNOS Archive,
[18] Società Nazionale delle Officine di Savigliano. 1914. *Tipi di Costruzioni Metalliche*. Torino: SNOS.
[19] Stern, E. 1930. "Recent Airplane Hangar Construction in Europe." In *Architectural Forum.* April.
[20] Voormann, F. 2009. "The Use of Welding in Civil Engineering. Conditions of a Technological Innovation in the 1920s." In *Proceedings of the Third International Congress on Construction History,* 3.
[21] Zordan, M. 2006. *L'architettura Dell'Acciaio in Italia*. Roma: Gangemi. (in Italian)
[22] Zorgno, A. M. 1988. "Guido Fiorini e le Officine di Savigliano." In *Casabella* 549: (in Italian)