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THE INDUSTRIALIZATION OF CONSTRUCTION IN THE SECOND HALF OF THE XX CENTURY

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LAVENO STREET HOUSES BY MARCO ZANUSO. AN OUTSTANDING EXPERIMENT IN LIGHTWEIGHT PREFABRICATION

Giovanni Conca

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Abstract

The paper focuses on one of the most interesting experiences in Italy about light prefabrication, developed by the Milanese architect and designer Marco Zanuso (1916-2001), a major protagonist at the national level in the debate on building industrialisation, together with the company FEAL (*Fonderie Elettriche Alluminio e Leghe*), an important Italian enterprise developing steel construction systems and producing aluminium building components. In the first half of the 1960s, Zanuso experimented with the VAR/M3 prefabricated system produced by FEAL for school buildings and tested its application to two housing complexes in Milan. Using this system, Zanuso built two apartment complexes, both in Milan one at Laveno Street (1960-1963) and the other at Solaroli Street (1965-1967), now Coari Street. The first of these two projects is especially significant for its experimental approach and the formal result achieved, which was favourably received by critics at the time but is still little studied today.

Keywords

Marco Zanuso, FEAL, Laveno Street Houses, Lightweight prefabrication.

Giovanni Conca
Fondazione Archivio del Moderno, Università della Svizzera Italiana, Balerna (Switzerland)

Corresponding author:
e-mail:giovanni.conca@usi.ch

1. INTRODUCTION

In Italy, after the World War, the industry significantly developed mainly in the mechanical sector, but the building practice remains primarily tied to traditional masonry construction methods. Even the most modern and advanced concrete technology grows, in fact, in a substantially handcrafted manner, which «does not entail an industrial conception of building construction but stands as an evolved version of masonry work» [1].

In such a context, the use of steel, which had characterised some important experiences in the pre-war period, retains its episodic character, even if there are also experiments for a revival of metal construction. Due to the expansion of the steel industry and thanks to the promotional activity carried out by lots of magazines, among them *Costruzioni Metalliche* published since 1949, a greater awareness of the technical possibilities offered by light prefabrication spread in the 1960s. These changes lead to a series of important realisations by well-known designers, from workplaces to commercial buildings.

At that time, we face the development of two strands in metal construction research. The former is directed towards the study of the curtain wall, considered a typical element of modernity; the latter, on the other hand, attempts to pursue an Italian line characterised by a form of the expressive potential of structural steel skeletons.

Unlike the international framework, Italian designers start exploring metal construction as a technology with specific characteristics and a linguistic field only from the end of the 1950s, mainly in office buildings. For the first stand, there are a series of exemplary works, such as the *Centro Direzionale Eni* by Marco Baciagalupo and Ugo Ratti (1960-1962), that remained for years the largest steel building constructed in Italy, and the ESSO headquarters at EUR (*Esposizione Universale di Roma*) by Luigi Moretti (1961-1965). There are also less important examples, but significant at the same time, including the RAI Management Centre by Francesco Berarducci and Alessandro Fioroni (1961-1965) and the INA (*Istituto Nazionale delle Assicurazioni*) complex by Venturino Ventura (1960-1961). These buildings, where the main structure and the façade are made of steel, are flanked by others, such as the office building in Via Torino by Adalberto Libera (1957-1958) and the Pirelli skyscraper in Milan by Gio Ponti (1955-1960), for which the frame structure is in concrete, and all façades in a glass and aluminium curtain wall. To the second line of research, closer to constructive realism and characterised by structural expressionism, we can list works such as the *Rinascente* in Roma by Franco Albini and Franca Helg (1957-1961), the ADISU (*Azienda per il Diritto allo Studio Universitario*) headquarters (1967), also in Roma, by Enrico Mandolesi and the office building in Piazza Meda in Milan by BBPR (1969).

The exponential population increase at the beginning of the 1960s determined the political and social urgency to build many schools in a short time and at a low cost [2]. Therefore, the Ministry of Education launched a public programme to adopt alternative construction techniques to develop lightweight prefabricated dry-mounted systems. In 1960, the XII Triennale di Milano set up the *La Casa e la Scuola* (The Home and School) Exhibition, promoting several collateral initiatives, including the *Competition for the study of industrialised elements for elementary school buildings*.

The prefabrication topic, which was already widespread abroad, start to be discussed by the major designers who, in these years, establish various partnerships with some enterprises (Disertori-SALVIT, Magnaghi-Terzaghi-SNAM, Albini-SECCO, Minoletti-HOLIDAY, Pellegrin-BENINI, Pellegrin-Pea-MONTEDISON, Valle-VALDADIGE). The design challenge of prefabrication begins: it gives rise to a series of interesting experiments. Industrialisation quickly extends from school buildings to residential buildings, where steel frames and light metal components were not employed, but heavy prefabrication with concrete panels on the French model was employed. The only notable exceptions among the numerous *INA-Casa* Plan construction sites are the Prà district in Genoa (1960-1961) and the CECA (*Comunità Europea Carbone e Acciaio*) district in Piombino, Livorno (1963-1967), both built by the steel company Italsider for its employees. The synergy between Marco Zanuso and FEAL (*Fonderie Elettriche Alluminio e Leghe*), leading to the realisation of the houses in Milan at Laveno Street and those at Solaroli Street between 1960 and 1965, is particularly significant. Using the prefabricated VAR-M3 System developed by FEAL for school buildings, Zanuso is one of the first architects to use light prefabrication for a residential complex, paving the way for the debate on open-cycle building industrialisation with metal components that would only develop in the following years.

2. FOR INDUSTRIALISED CONSTRUCTION: MARCO ZANUSO AND FEAL

After the war, Zanuso was interested in industrial prefabrication within the debate promoted by the MSA (*Movimento Studi per l'Architettura*), publishing in the first issues of *Domus* magazine, together with Paolo Chessa, three articles titled *The prefabricated house*. In these writings, Zanuso and Chessa declare a clear programmatic purpose to renew building methods according to the possibilities offered by industry: «[…] we cannot longer think of construction as modelled, cast, conglomerate – the two architects write – but assembled. We must think of construction elements, prefabricated in the workshops and mounted on the building site using exact and well-defined jointing pieces» [3]. The focus is therefore on the «ready-to-assemble element», which provides for the home «an organisation of transport and assembly as for any other industrial product, such as cars, aircrafts, boats» [4]. The adoption of the first seven

years of the *INA-Casa* Plan inhibits and interrupts the debate on building industrialisation, promoted by several Milanese architects and partly tested in the well-known QT8 (*Quartiere Triennale 8*) district. Despite this, at the *Convegno del progresso edile*, held in Milan in April 1953, Zanuso relaunches the idea of an architectural design approach based on the *industrial model*. In his intervention, the Milanese architect declares his aim to establish a replicable *principle* that has «as broad a validity as possible in adhering to similar requirements» and also states that «the house is an object of use» [5]. During the same year, Zanuso has the opportunity to visit some schools in England built by the county of Hertfordshire following prefabricated and modular systems. This trip represents for the Milanese architect a revelation about the potential of building industrialisation. The travel notes include sketches of the building systems adopted in some of the English schools built in those years, including the Templewood School in Welwyn Garden City (1948-1950) [6]. Zanuso remains particularly impressed by this experiment in social architecture by using industrial methods, and the following year, he writes an article for *Casabella* magazine about the school planning experience in England. By publishing in the magazine the *punt system* which is a simple, modular structural scheme, consisting of pillars, main beams and punts (elements with which the roof is constructed, alternating with simple closure panels), designed by the engineer Ove Arup Zanuso is aware of a functional way of building, not based on finished elements and their assembly, but on «a constructive simplicity, a structural evidence, materials economy and especially a compositional flexibility» such as to confirm his conviction that industry can «take part in architecture as a propulsive energy of new forms and new compositive freedom» [7]. In this way, Zanuso renews his interest in architecture, which is closely linked to industrial design and building industrialisation matters. However, the Milanese architect believes that industrial construction should not be limited to standardized buildings but should be oriented towards open prefabrication that, through many combinations and a wide dimensional range of mass-produced components, can provide an efficient and sufficiently adaptable approach to building.

Zanuso finally has the opportunity to implement these intentions through relationships he establishes with engineer Giovanni Varlonga, a member of ADI (*Associazione per il Disegno Industriale*) since 1957 and founder of FEAL founded in 1945 in Milan, which initially produced die-cast joints and later expanded production into building components (door and window frames, handles, false ceilings, movable walls, radiators, roofing and façade panels). For the innovations brought in the field of construction, FEAL excels among other companies and, in the 1960 award edition of the *Premio Compasso d'Oro*, it receives an honourable mention for the up-and-down window frame and is also awarded for the aluminium radiator *Thermovar*. Varlonga is involved, already in the 1950s as an industrialist and designer, on lightweight prefabrication: at the X Triennale in 1954, FEAL had, in fact, participated with the *Industrialised Vertical House Element*, designed with engineer Fabio Fratti of the company's Technical Office and in collaboration with architect Ippolito Malaguzzi Valeri (Fig. 1). In later years, FEAL begins intensive activity in exhibition construction, reaching international notoriety, and patents several metal building solutions (Fig. 2). In the mid-1970s, at the top of its economic success, FEAL comes to own three operating divisions: Components (to manufacture the components in its two plants in Milan and Pomezia), Construction (to design civil and industrial buildings), and Plants (to set up industrial complexes for production). Other than Salvit of Milan, FEAL becomes the leading company in Italy to develop open-cycle lightweight prefabrication, developing in the late 1950s the VAR-M3 dry modular system (Fig. 3). The VAR-M3 system, then modified and commercialized until the 1980s, uses a 30 cm base module on which all other components are sized in multiples and submultiples. Zanuso plans to test the feasibility of applying to housing construction the VAR-M3 system, employed until then for school buildings, checking «its versatility in responding to a need of architecture, for richer and more complex volumetric articulation, with the possibility of being used with different materials and coexisting with other complementary building systems» [8].

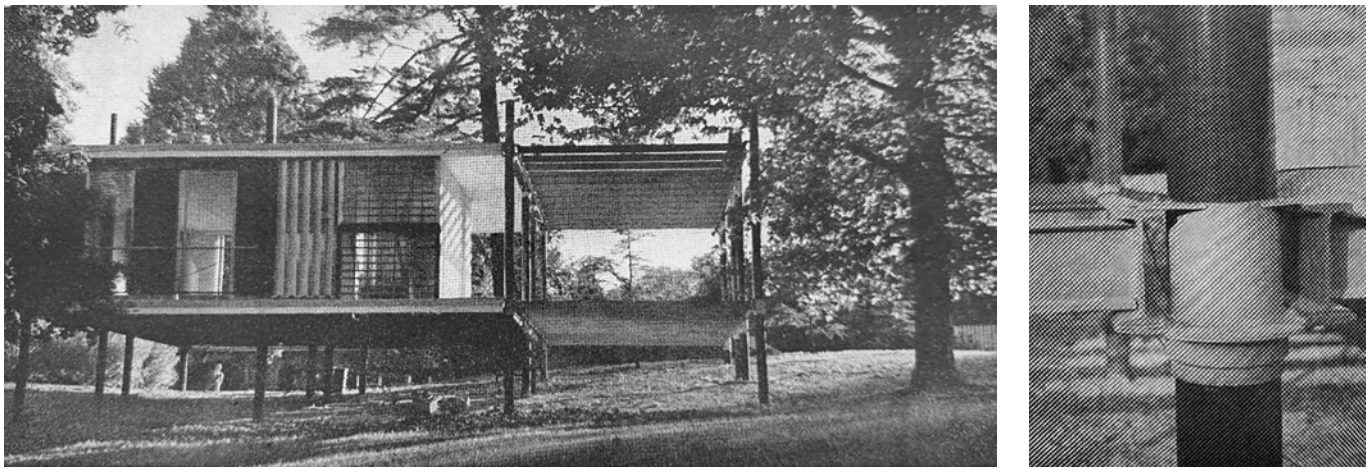

Fig. 1. *Right: Industrialised Vertical House Element at the X Triennale in 1954, designed by FEAL. Source:* Casabella *203. Left: Detail of Vertical House Element at the X Triennale. Source:* Casabella *203.*

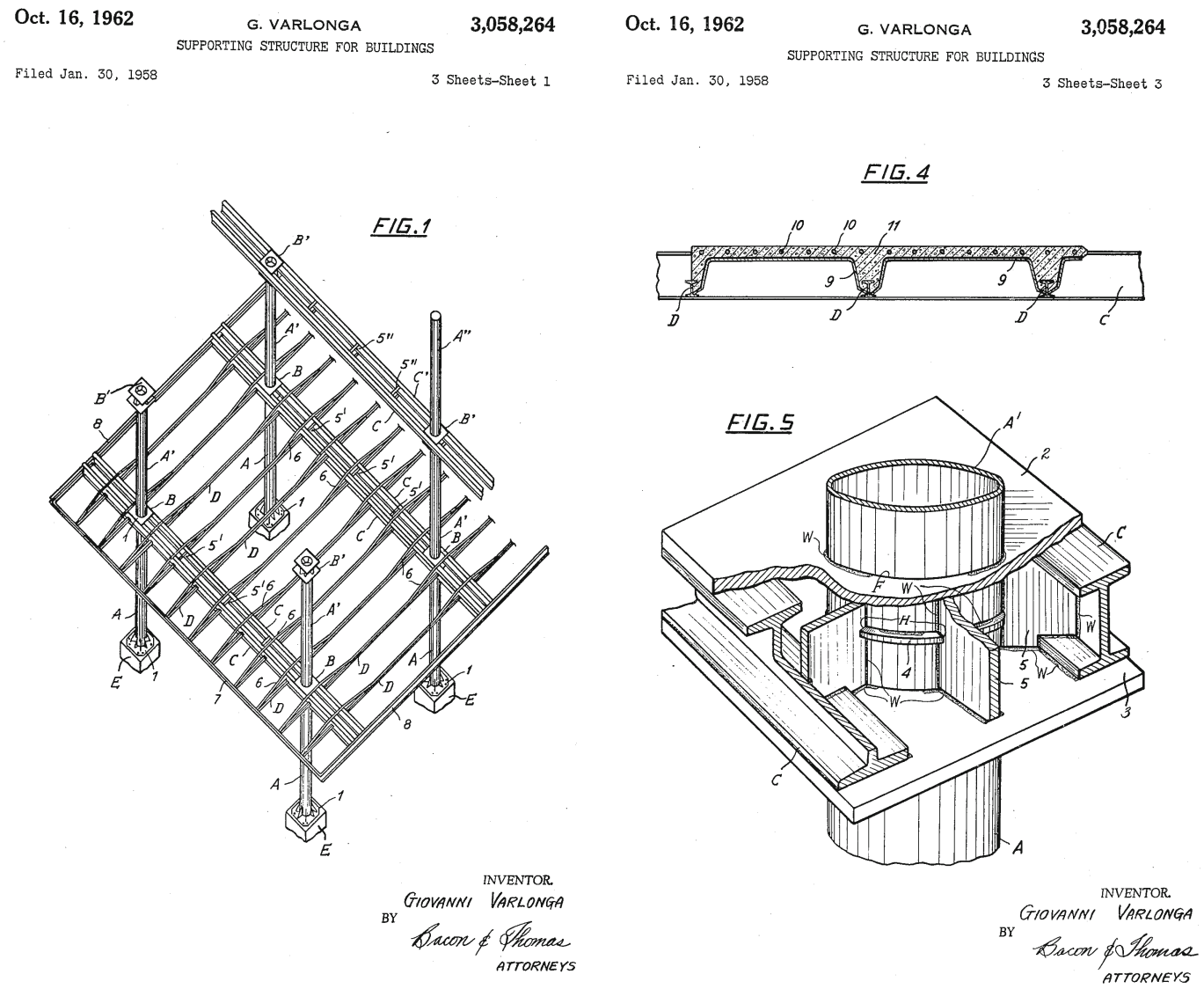

Fig. 2. *Patents of the load-bearing steel frame structure. Source: Google Patents.*

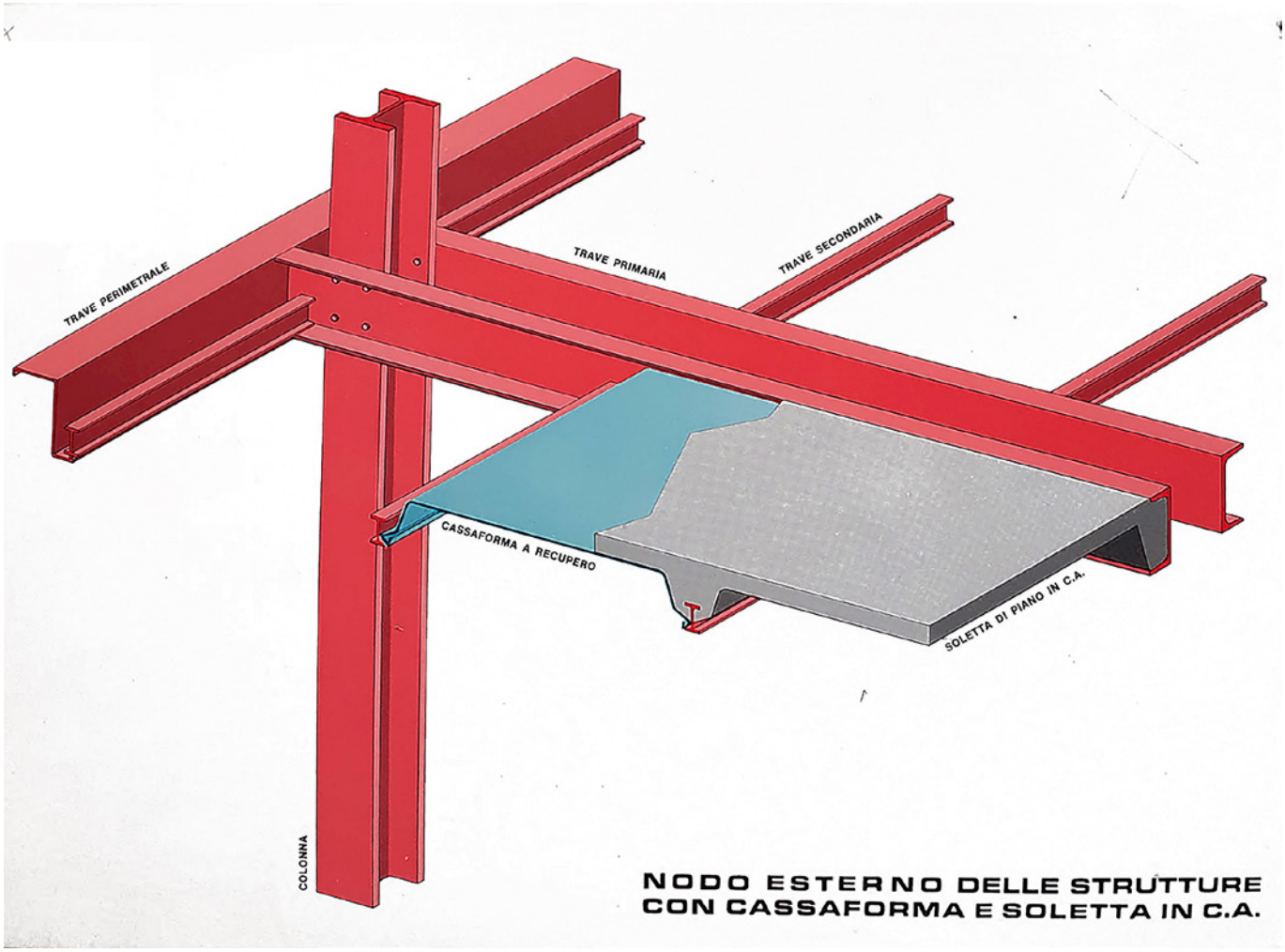

Fig. 3. *VAR/M3 system steel structure. Source: catalog, Var M3:* sistema coordinato di edilizia industrializzata*, n.d. [published after 1975].*

3. LAVENO STREET APARTMENT COMPLEX: A PROTOTYPE FOR MASS-PRODUCED LIGHTWEIGHT PREFABRICATION IN HOUSING

The project for FEAL Houses at Laveno Street fits fully into the debate on building industrialisation relating to low-cost and social housing, especially rooted between the 1950s and 1960s in the Milanese context. In the municipality's deeds, it is pointed out that the publicly owned building area is granted «for the construction of social and affordable housing» to be assigned to the members of the Edilvar cooperative.

It is important to premise that the theme of affordable housing already interested Zanuso at the end of the 1940s when he designed several affordable houses: the best known of them are those built for veterans in the QT8 district in Milan (1947-1948) with Roberto Menghi.

Even in the second half of the 1950s, as a municipal councillor, Zanuso worked on social housing initiatives, presenting reports and a motion to the city council in 1960 on the housing problem [9]. Although he is by now an established designer and architect with many projects in progress, in these years, he takes part in one of the many urban planning projects of the *INA-Casa* Plan, the largest urban development programme promoted by the Italian government. Indeed, together with Luigi Caccia Dominioni, Alberto and Gian Paolo Valenti, he designs the *INA-Casa* Vialba I district in the northern suburbs of Milan between 1957 and 1960. However, the standardization and prefabrication hypotheses advocated by Zanuso and other Milanese architects since the immediate post-war period clash with a situation still characterized in the 1950s by construction techniques that remain craft or semi-craft-based. Despite being the most im-

portant social housing experiment in Italy, the *INA-Casa* Plan has been conceived to increase employment, requiring a high labour input for building houses and excluding the widespread use of prefabrication. This *anti-industrial* approach finally seems to be overcome, at least in part, at the beginning of the 1960s, when Milan is the scene of some political changes and sees a more concrete technological development in the field of construction due to some important initiatives. The ever-increasing population growth affecting the metropolis since 1951 and the consequent need to provide housing become the main issues for the city council. In 1962, Piero Bassetti – budget councillor of the first centre-left council elected in 1960 with Gino Cassinis as mayor – entrusts the IACPM (*Istituto Autonomo Case Popolari di Milano*) with a four-year plan for social housing, expecting to build 34,000 flats and approximately 120,000 rooms. A year later, the Municipality of Milan also approves the PEEP (*Piano per l'Edilizia Economica e Popolare*), which set out the location of sixteen public housing projects in peripheral areas of the city, including the Sant'Ambrogio district, the Gallaratese completion, Gratosoglio district, Missaglia district, the Olmi district and the Quarto Cagnino district. In May 1955, on the IACPM's initiative, the CRAPER (*Centro per la Ricerca Applicata ai Problemi dell'Edilizia Residenziale*) is also established, with the aim of investigating the urban, social, economic, productive and technical issues of social housing. A fundamental contribution to the debate on prefabrication is provided by Giuseppe Ciribini's studies on using the production and organisational methods of industry in construction. Due to Ciribini's dense relationship network with French institutions, the IACPM, in order to cope with the construction of social housing in a short timeframe, stipulates an agreement in 1962 with several building firms (including Mbm Meregaglia, Sicop, Fintech, Sepi, Romagnoli) holding French patents for heavy prefabrication. Already used for grands ensembles, these French heavy prefabrication systems – such as Balency, Barets, Camus, Coignet, Fiorio, and Costamagna – are now being used for the construction of the new housing districts in the Milanese suburbs [10, 11].

Therefore, if research and practical applications are moving towards heavy prefabrication, in which France is the most important reference point, the all-Italian experimentation of light prefabrication conducted by Zanuso and FEAL appears to be countertrend and particularly innovative. In fact, the Milanese architect opts for a more flexible building industrialisation that is compatible with the Italian small business and does not need overly burdensome investments. Precisely in the Laveno Street Houses, one of the first experiments in Italy on lightweight prefabrication in housing, we can see Zanuso's commitment to exploring «the margins granted to expression by the adoption of a prefabricated structure», as well as «a tendency to bring the problems of design back to the exclusive dimension of technology» [12].

Zanuso is probably in charge of the two buildings at 6 Laveno Street in early 1960 (Fig. 4). In October of the same year, an enquiry on industrialised construction, entitled *Investigation at FEAL*, is published in *Stile Industria* magazine, with contributions by Gianni Varlonga, Giuseppe Ciribini and Marco Zanuso. In his intervention, the Milanese architect credits FEAL with a courageous

a) b) c)

Fig. 4a-b-c. *FEAL Houses complex views. Source: Archivio del Moderno, Fondo Marco Zanuso, Balerna.*

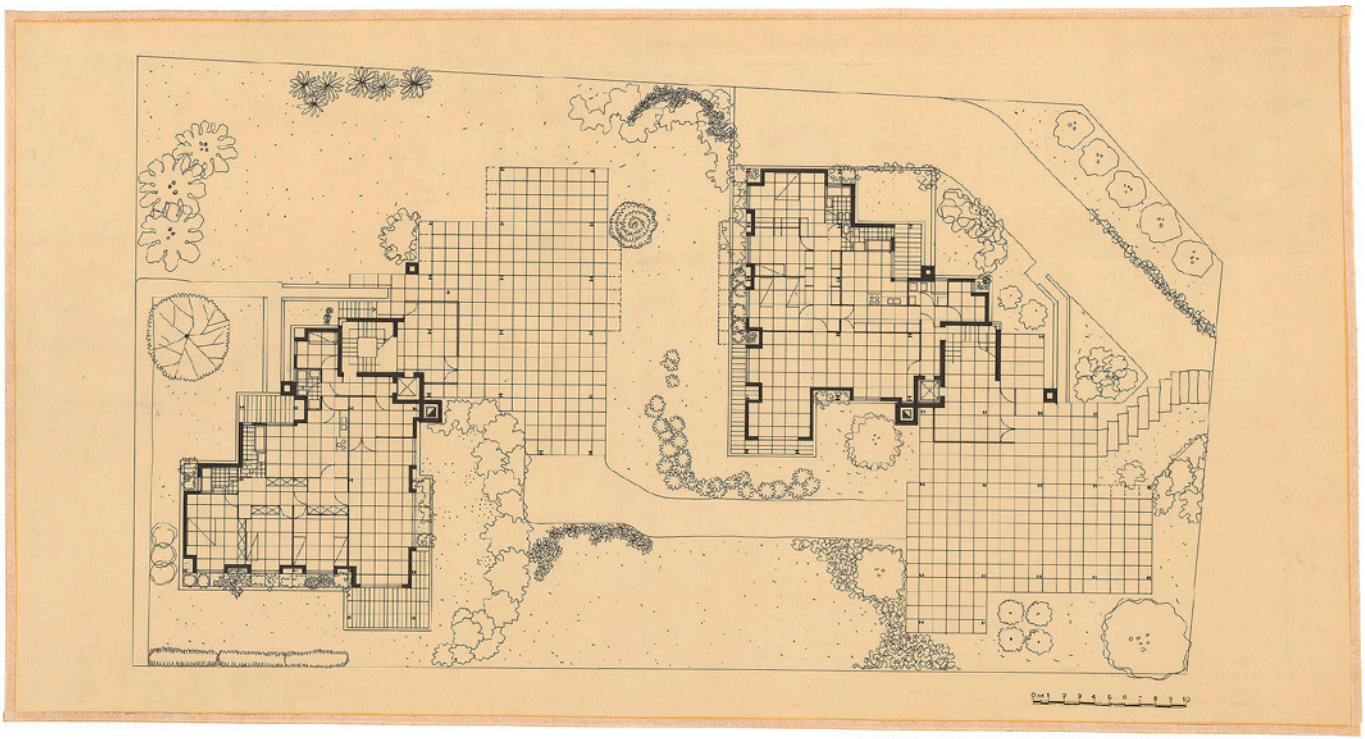

Fig. 5. *FEAL Houses on Laveno Street floor plan. Source: Archivio del Moderno, Fondo Marco Zanuso, Balerna.*

commitment to the problem of modular coordination and building industrialisation. «The experience gained on each construction site, which usually comes to be lost, has been gathered here – says Zanuso – in a wealth of experimental data such as are an industrial complex can condense. Every rabbet, every seam, every joint has been tested, modified and led to a point of perfection that is the only guarantee of a product» [13].

From documents kept in the Archives of the City of Milan, we learn that the developer and owner of the plot at 6 Laveno Street is the Edilvar Cooperative, with engineer Fabio Fratti as president in charge.

In April 1961, the Municipality and the Cooperative sign an agreement to sell the land: two residential units are to be built within two years, and the apartments must be assigned only to members. Among others, Giovanni Varlonga, Fabio Fratti, and Marco Zanuso himself, who will move his studio there. As early as the first draft project, drawn up between January and February 1961, the twin buildings are set rotated 90° to each other, with access from the short side of Laveno Street. The buildings' perimeter is very jagged, and the two apartments on each floor, distributed by a concrete staircase, are arranged on staggered levels (Fig. 5).

The VAR-M3 system on a 90 cm module, triple the basic 30 cm module, is used in construction. The load-bearing structure is made of steel HEB 180 pillars and main beams made of two NP 240 C-profiles, to which secondary beams (double-T NP 80 profiles) are welded. The edge beams are bolted to the main beams, and on them, the curtain wall uprights (IPE 100 profiles) are fixed with galvanized steel plates, which support the brackets for mounting façade panels. The floors are assembled on the ground, with reusable aluminium formwork set up between the secondary beams for slab casting, then lifted with a crane along the steel columns, used as a guide, and finally bolted in place [14]. Fabio Fratti specifies that in Zanuso's project, the windows on the façade are up-and-down, while those on the loggias are two-sash sliding. Windowsills and light alloy frames are fixed to the uprights by special aluminium fittings [15]. The interior walls are realized with modular panels, consisting of two steel plate surfaces stiffened by metal profiles on the inside and finished with baked-on paint. The suspended ceilings are of the *Soundvar* type, also produced by FEAL, with 15 cm wide aluminium slats suspended from galvanised sheet metal rails.

Fig. 6. *Vico Magistretti, Office building at 22 Corso Europa, Milan (1955-1957). Source: Irace F, Pasca V (1999). Vico Magistretti architetto e designer. Electa, Milano. Photo © Gabriele Basilico.*

The VAR-M3 system is creatively used by Zanuso, who succeeds in the extreme compositional flexibility of prefabricated modules by adopting standard elements. In the project report, the architect himself recalls how he concentrated «on the modularity of the concave and convex corner joints» [16]. The layout of the uprights on the façade follows, with some exceptions, the 90 cm module, while the structure grid of the pillars fits a module of 30 cm. The pillars are offset to the 90 cm grid, allowing Zanuso compositional freedom to respond to the different functional needs of the floor plan. The structure's geometry appears at the portico level, where the columns are free and form a main span of 6 m and a side span of 4.8 m with intercolumniations varying from 4.2 m to 3.6 m. The different modularity between columns and envelope produces two different geometric layouts that create unexpected variations that are totally surprising in a prefabricated building based on a strictly modular approach. Besides technical and constructive experimentation, the Laveno Street buildings also reveal particular care in the use of materials and design of the façades, characterized by the vertical rhythm of uprights and openings. The main modification that Zanuso introduces in the VAR-M3 system concerns the prefabricated panel, 6 cm thick, composed of polyurethane insulation enclosed inside by a steel sheet and outside by an aluminium one.

The Milanese architect thinks of transforming a conventional curtain wall into a particularly textured wall face: he adds a natural stone slab (*piperino* grey trachyte) to the standard panel, with a glass wool cavity in between. The solution proposed by Zanuso thus blends lightweight prefabrication technological innovation with a close reference to the Milanese building tradition.

The VAR-M3 system's modularity hence characterises the two buildings, but at the same time, their image is not monotonous but instead is articulated in depth and height by the protruding volumes and voids of the balconies. Similar research on façade composition with prefabricated panels and expressive interpretation of the curtain wall can also be found in some contemporary works by Vico Magistretti. In the first case, reference can be made to the building designed by Magistretti at 3 San Gregorio Street in Milan (1957-1959), where the façade is marked by irregularly spaced pillars, clad in granite and rotated by 45°, and by a prefabricated concrete panel cladding with a characteristic burgundy-coloured grit finish (Fig. 6). As in the buildings at Laveno Street, the laying of the panels is irregular, while the particular colour solution is a successful reference to the brick wall of the nearby Lazzaretto. Additionally, in this project by Magistretti, it is interesting to note the vertical shape of the opening, which is likewise taken up in Zanuso's apartment complex. The use of such proportions is not an insignificant detail: these openings clearly differ from the typical rationalist window as seen in Milan in some buildings. The most known typical examples are Casa Rustici (1935) by Terragni, where the reinforced concrete frame enlarges the holes horizontally; the Palazzo Montecatini by Gio Ponti (1936); the famous apartment block by Asnago and Vender at Albricci Street (1939-1942/1953-1956), where windows keep the vertical aspect but with a less slender proportions, often emphasised by the vertical bipartition of the window frame; or the Case Albergo by Luigi Moretti (1950), with still horizontal holes.

On the contrary the windows at San Gregorio Street and those at Laveno Street find references in other buildings, such as *Casa al Parco* (1948) by Ignazio Gardella and Caccia Dominioni's house in Piazza Sant'Ambrogio (1949). However, the most direct reference is to Milano's historical and popular housing, often characterized by full-height windows with metal parapets and wooden shutters. Nevertheless, in their buildings, Magistretti and Zanuso focus on another opening type, smaller in width, which creates a more articulated and wavy composition. The shape is still rectangular, but the small size and very stretched proportions make these openings look like cuts engraved in the wall that recall Lucio Fontana's canvas with vertical slashes. In the Laveno Street building, these *arrow slits* emphasised by the proximity of the aluminium uprights, produce a particularly marked and original caesura, breaking the curtain wall's regularity. As far as the expressive interpretation of the curtain wall is concerned, an emblematic example is the building in Corso Europa (1955-1957), also designed by Magistretti, where the façade is punctuated by pillars, uprights and a vertical ribbon window (Fig. 7). The graphic layout of the

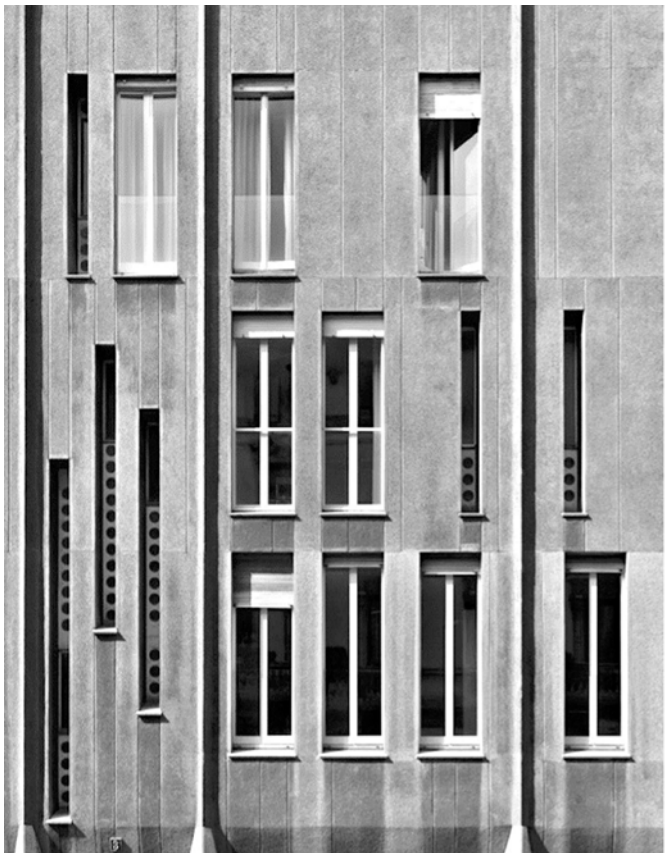

Fig. 7. *Vico Magistretti, Residential, office and cinema building at 3 San Gregorio Street, Milan (1957-1959). Source: Facecity scrool 2012. Photo © Pino Musi.*

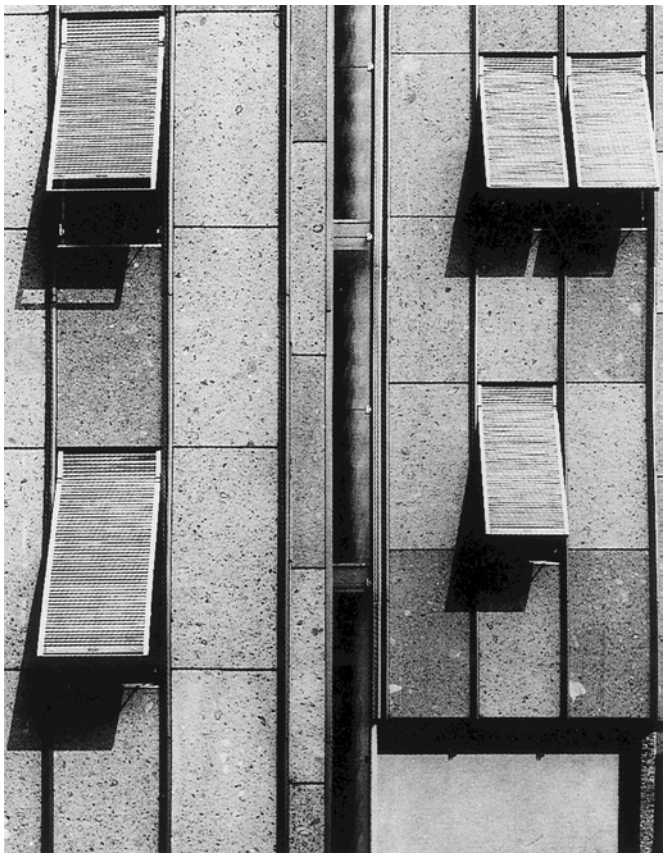

Fig. 8. *FEAL Houses detail façade. Source: Archivio del Moderno, Fondo Marco Zanuso, Balerna.*

openings is carefully studied, using construction solutions already on the market and employing standard window frames. Magistretti designed a module, repeated six times in each bay, with the glazed part in the shape of an asymmetric T (the two sidebands are of different widths) and two low areas at the sides in polished white granite slabs. The façade's dynamism, resulting from the vertical glazed bands and pillars, and the juxtaposition of various-sized windows in Corso Europa recall the vertical rhythmic scansion and window modules of the Laveno Street building. Although with different outcomes, these two projects belong to a broader line of research on the curtain wall topic, mainly experimented by Milanese architects. Interestingly, the appeal of curtain wall development in Italy came precisely from the world of industrial design. Some issues of the magazine Stile Industria at the end of the 1950s published extensive reports on the spread of the curtain wall in other countries, also delving into technical aspects and propagating Italian examples mainly by Milanese architect-designers [16-18].

However, the façades of Magistretti and Zanuso's buildings do not replicate the usual and anonymous curtain wall model widespread in other countries; they arise from specific experimentation and a particular project reinterpretation. Both examples are representative of an *Italian-style curtain wall*, as defined by Sergio Poretti, where the international language of the glass and metal façade «is subjected to such a minute reworking that it eventually turns into local dialect, enriching the variegated range of intonations of Italian modernisms» [19]. Indeed, although Magistretti and Zanuso use prefabricated elements, their buildings do not result from a simple assembly but are characterized by a distinctive compositional expressiveness in the façade design.

These considerations provide a better understanding of the original construction experiment carried out by Zanuso in the Laveno Street complex: the modern lightweight prefabrication technique is combined with the Milanese building tradition and historical reminiscences about parapets design of the terraces and balconies, which, resem-

bling battlements, allude to the debate on environmental pre-existences arising around the Velasca Tower (Fig. 8). Despite the success of the FEAL Houses project, published in several magazines and awarded the prestigious national *IN/ARCH* prize for Lombardy region in 1966, Zanuso does not hide his regret for an interesting experiment that should have been continued «above all to explore the opportunity offered by the modular approach in the use of natural materials and dry assembly techniques» [8].

4. CONCLUSIONS

All efforts led by Zanuso and other architects, primarily Enrico Mandolesi, to promote lightweight prefabrication in housing were unfortunately unsuccessful. In the mid-1970s, due to the economic crisis, hypotheses about building industrialisation remain confined to a narrowly defined horizon. The use of steel by industrialised methods gradually decline even in those fields in which it has found wide use, while within industry, experimentation returns to the technological aspects, focusing on research and the use of new materials.

This epilogue does not detract from Zanuso's research on lightweight prefabrication, which – though isolated – represents an important milestone in the history of twentieth-century Italian construction.

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