

## REINFORCED CONCRETE AND CONCRETE PREFABRICATION CONCEPT IN LE CORBUSIER'S SCOPE OF WORK - CONDO BUILDING IN MARSEILLES 1945-1952

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Subject review

In this article, that was based on research of original archive designs from Fondation Le Corbusier in Paris, especially on executive plans of the first after the war constructed condo building in France (Marseille, Boulevard Michelet 280), the author is analyzing the development of reinforced concrete constructions and the use of specific prefabrication technology in Le Corbusier's scope of work, one of the greatest architects of 20<sup>th</sup> century. The aim of the article is to show his unique and complex approach to shaping the reinforced concrete and use of prefabrication, and perhaps the possibility of contemporary use of design solutions of Marseilles condo prototype. The article also presents the development of Le Corbusier's vision of multi-condo buildings which were constructed after the 2<sup>nd</sup> World War. Because of the architect's specific approach to designing, which was enabled by using reinforced concrete, during that time those buildings presented an example of comfort and quality of living par excellence.

**Key words:** reinforced concrete, Le Corbusier, Marseille, prefabricated construction, multi-condo building

### Konceptije armiranobetonskih i prefabriciranih konstrukcija u opusu Le Corbusiera - Višestambena zgrada u Marseilleu 1945.-1952.

Pregledni članak

U članku koji je temeljen na istraživanju izvorne arhivske građe iz Fondation Le Corbusier u Parizu, ponajprije izvedbenih projekata prve velike realizirane poslijeratne višestambene zgrade u Francuskoj (Marseille, Boulevard Michelet 280), autor analizira razvoj armiranobetonskih konstrukcija i primjenu specifične tehnologije prefabrikacije u opusu Le Corbusiera, jednog od najvećih arhitekata 20. stoljeća. Cilj je članka ukazati na njegov jedinstven i složen pristup oblikovanju armiranog betona i upotrebi prefabrikacije, te na eventualnu mogućnost suvremene primjene projektantskih rješenja marseilleskog stambenog prototipa. U članku je također iznesen razvoj Le Corbusierove vizije višestambenih zgrada koje su realizirane tek nakon Drugog svjetskog rata, a koje zbog arhitektovalog specifičnog pristupa projektiranju, koje je u prvom redu omogućila upotreba armiranog betona, u svoje doba postaju primjer udobnosti i kvalitete stanovanja par excellence.

**Ključne riječi:** armirani beton, Le Corbusier, Marseille, prefabricirana konstrukcija, višestambena zgrada

#### 1

#### Uvod

#### Introduction

Use of reinforced concrete in condo building construction has enabled development of modern ground-plan design of condos. The inventor of reinforced concrete, August Perret, by the end of the 19<sup>th</sup> century designed the first condo building. The first designed building was built in the year 1907 in rue Franklin 25bis street in Paris, just a few years after the second designed but first built non-industrial reinforced concrete building in the world, the Saint Jean-de-Montmartre church (1904). The church was built and designed by another great French architect and Perret's coeval Anatole de Bado. Perret's first design doesn't show any progress in modern design, since it still shows the same behavior as used in block urbanism, organized with corridor rooms orientated towards the main street facade. Modern architecture shows first concepts of modern condo design during the 1920's ruled by the sides of the world. That characteristic modern design of living space in condos was, in contrary to urban examples for classical block building design, the fundamental stage of a new functional urbanism of 20<sup>th</sup> century developed under supervision of C.I.A.M. (Congrès internationaux d'architecture moderne – International congress of modern architecture) 1928-1959.

The use of reinforced concrete and its characteristic frame bearing construction had two main aspects visible in designing and in urbanism:

- 1 A possibility to open the northern façade, which wasn't a bearing one any more (as weren't the other outer walls either),
- 2 Constructing the buildings on columns, this was a starting point for avant-garde concepts of a building

completely separated from the earth. The separation from the earth symbolized the separation from the nature and primary social occupations.

Although the first non industrial building that was built after the Saint-Jean de Montmartre church, which uses reinforced frame construction, was Théâtre des Champs Élysées – built by the famous Auguste Perret – the "father" of reinforced concrete was not the first architect to use the new possibility of ground-plan design enabled by the use of the new structural system. Until the 1910s and 1920s the technical abilities of reinforced concrete were not used, when Le Corbusier completely exploited them in his visions of the city and the architecture of the future. His questionable project "Dom-ino" from 1914, named after a well known game, with the aim to evoke multiple possibilities of combinations and of setting together of the construction, was a great example how to use reinforced concrete. It also shows the simplicity of stabilization of reinforced concrete columns with horizontal plates, with a possibility of multiplying and growing in every direction, if needed. The project was also the first explicit examination of possibilities using a new material in pure esthetical frames of its logistics – showing the constructional elements without hiding and decorating the same.

On the other hand, the frame construction system used by Le Corbusier after the 2<sup>nd</sup> World War for constructing condo buildings, has derived to a projection of the new material that ought to be used, and not its constructional specification. The specific use of reinforced concrete in classical way, characterized by forming in complex wooden scaffolding with natural concrete look ("béton brut") – recognizable by precise and time consuming "in situ" construction – resulted in increasing use of prefabrication on his buildings. This way, Le Corbusier's reinforced

concrete condo buildings composed with a large amount of prefabricated concrete parts present two sided "monolith" sculptures, reminding of a perfect product from a foam and a breakthrough example of a technology which enables production of parts, away from the construction site.

Although prefabrication and standardization weren't Le Corbusier's invention, in his scope of work they were the final (but never carried out) aim of his technical solutions.<sup>1)</sup>

This article is based on archive work from Fondation Le Corbusier in Paris, especially designs of the first condo building constructed after the war in France (Marseille, Boulevard Michelet 280). The author is analyzing the development of reinforced concrete constructions and use of prefabrication in one of the greatest architect's scope of work of 20<sup>th</sup> century. The archive study is mostly based on designs of the first large and constructed condo building after the war in France. The aim of this article is to present Le Corbusier's unique, yet complicated approach to reinforced concrete forming and use of prefabrication. Also the aim is on eventually showing the possibility of contemporary use for Marseilles condo prototype design.

## 2

### Le Corbusier's vision of condo buildings development and urban aspects of constructing them on reinforced concrete columns

Razvoj Le Corbusierove vizije višestambenih zgrada i urbanistički aspekti njihove izgradnje na armiranobetonskim stupovima

From three of Le Corbusier's concepts of collective accommodation only one has resulted with setting up a whole building on columns.

After the project "Dom-ino", dated from 1914's, first vision of condo building was "Immeuble-villas" (*immeuble de 120 villas superposées* – building with 120 condos - villa). The "Immeuble-villas" was developed almost at the same time as "Citrohan" house, which was one of the first visions of family accommodation on columns with a living space designed according to the new design possibilities. The name "Citrohan" has a note similar to a large French automobile producer known by avant-garde technical solutions. The similarity, though, was not coincidental. "Citrohan", dating from 1920's was the first building to use the frame system of "Dom-ino" design, similar to the self

bearing construction of a car. That, however, has enabled the "free" design without considering the bearing construction. During the 1920's, while the best construction solution was to construct a building with outer bearing masonry walls, confined with reinforced concrete framing construction and transversal stabilization walls, the new construction was an avant-garde solution.

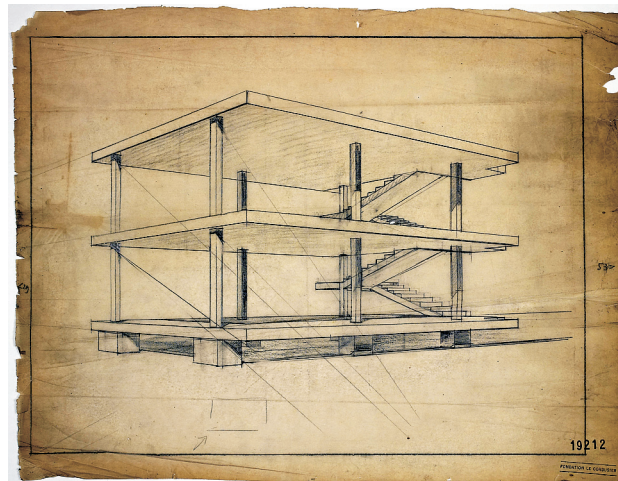


Figure 1 Reinforced concrete construction of the "Dom-ino" (1914) house – axonometric view; FLC 19212  
Slika 1. Aksonometrijski prikaz armiranobetonske konstrukcije kuće "Dom-ino", 1914.; FLC 19212

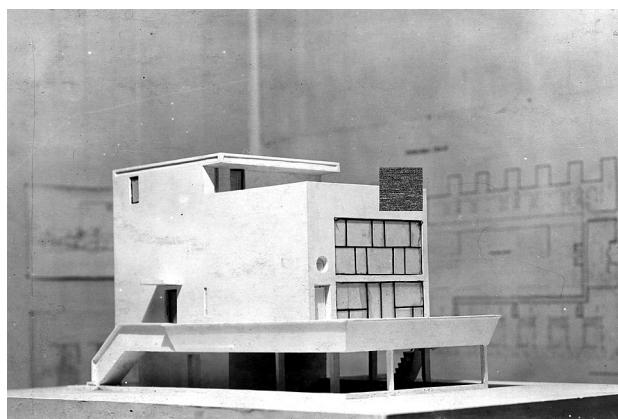


Figure 2 "Citrohan" house, photo of the model; FLC L3(20)9  
Slika 2. Kuća "Citrohan", fotografija makete; FLC L3(20)9

<sup>1)</sup> Author is pointing out to the important work of the architect Jean Prouvé designing and constructing of the buildings, especially after the 2<sup>nd</sup> World War and during the 1950s. Jean Prouvé and Le Corbusier worked parallel on construction of temporary condos and accommodation for war refugees. The use of precast elements in architectural works of Jean Prouvé and Le Corbusier inspired modern architects decades later. One of by Le Corbusier inspired architects is also one of the greatest contemporary French architects Jean Nouvel. For constructing two social multi-condo buildings in Nimes (project "Nemauses", carried out during 1885.-1887.) he used elements usually used for railways construction (except for the construction of reinforced concrete bearing construction).

Jean Prouvé and Le Corbusier (with Charlotte Perriand) have also developed the design and modern technology for furniture production. About those and about the prefabrication of homes in more detail in [1, 2, 3]. About the relationship between Le Corbusier and Jean Prouvé for the concept of industrial element prefabrication development, and about joined work with Ateliers Jean Prouvé designing and constructing Le Corbusier's multi-condo building in Marseilles, which was according to Prouvé supposed to have only the bearing construction constructed in situ and the condos prefabricated set to place by cranes, in detail in [4].

In his vision of a modern city inhabiting 3 million people ("Ville contemporaine pour trois millions d'habitants", 1922), Le Corbusier has multiplied his design "Immeuble-villas". Such a vision, after "Cité industrielle" designed by Tony Garnier, was a the first large scale architectural vision of unification.

Second Le Corbusier's vision was presented during the 1930's named "à redant" (in free translation "cogged", possible reminiscence on de Vauban bastion fortresses). Le Corbusier used his visions for designing "Ville radieuse" (1930) – a vision evolved from a project "Ville contemporaine" characterized by "à redant" buildings situated on every side of administration center. This presented time and space independence, which was an advantage in relation to Garnier's "Cité industrielle", where the concept depended on natural environment.

Difference between "Immeuble-villas" and "à redant" was such that "Immeuble-villas" were semi closed, block shaped and "à redant" was meander shaped, which was



more acceptable because, just as a vision of a city, it had the possibility of never ending continuation. The idea was the starting point for Le Corbusier's vision of setting up a whole condo unit on columns – third Le Corbusier's building type – a concept for Marseilles condo building "Unité", the first great realization which presents the biggest composition over reinforced concrete and its constructive and esthetical qualities.

Le Corbusier developed the third type during his carrier's biggest "crossroad" – "L'Esprit nouveau" expo held during the year 1937 in Paris. During that expo, in "Pavillon des temps nouveaux" hall he presented a great condo building constructed for bastion Kellerman. The "Y" shaped building was supposed to be used for condo accommodation with the aim of reconstructing Paris center ("Le plan de Paris 37"), presented during the expo in 1937 for administrative and business towers.<sup>2)</sup> Those were the first of Le Corbusier's buildings constructed on columns.

Plans (eg. blue prints) of condo buildings for about 3000 inhabitants, shaped like a large lay down prism "floating" on columns, were designed during the year 1937. The blue prints were published in "Quand les cathédrales étaient blanches".<sup>3)</sup> The development of accommodation units with reinforced concrete frame structure, where Le Corbusier was designing "accommodation cells" lasted until summer of 1944, resulting with a precise model of two stories condo – "cellule-type". By the summer of 1945, when Marseilles ordered from Le Corbusier a print of his "Unité" design, that model presented working print for two-stories condo.

Collective accommodation model design started, as was mentioned before, during the year 1922, when the concept of "Immeuble-villas" showed up. After the visions of city designs from 1922 and 1930, designs were also developed during 1928/29, under Wanner project – a new "Immeuble-villas" project - the accommodation units on disposal also had two-stories gallery condos (the condos were now conceptually perfected). The work also continued within the idea of condo buildings published after "Quand les cathédrales étaient blanches" in "La maison des homes" from 1942.<sup>4)</sup>

Urban concept from 1922 and 1930 withholds an idea of vertical city-garden, built on columns, which would leave large unused surfaces of natural, or peripherally designed terrain. Unité concept – closed and self-sufficient units, ruled by organized human relationships – were supposed to be basic units of the city, which has grown from the first visions from 1922 to 1930. From the social aspect, constructing those, would have secured safe life in a community with families supplied with basic material and maximal spiritual and cultural needs.

Le Corbusier's utopia visions of urbanism, architecture and the future of the world, whose projection was presented by the concept "Unité", hides the meaning of inventing, using and shaping the construction with opened ground floor and massive natural concrete columns. The "Unités" natural concrete possibly presents the reflection of hard

living of the working class, for whom the project was developed.

### 3

#### **Development of planning and building Marseille's "Unité", big European project for multi-condo building** Genealogija planiranja i izgradnje marsejskog "Unité"-a, velikog europskog pothvata stanogradnje

In 1945 Marseille was a city destroyed in war preparing for the first renovation. Le Corbusier was not close to communistic government of the city and the mayor Jean Christofol. However, Raoul Dautry, his friend from the 2<sup>nd</sup> World War, who was minister of defence (1939-1940) and in 1939 ordered from Le Corbusier vision of "The green factory" ("Usine Verte"), became in 1944 the first minister of urban planning and reconstruction (1944-1945). As a minister, in August 1945, he ordered a project for the first multi-condo building after war in that country. It was the first Le Corbusier's project (who was 59 at the time!) ordered by the government. The discussion between Dautry and Le Corbusier from 1945 was published in "Le Point" in November 1950. The minister asks Le Corbusier which town he is urbanizing and which building is he making and Le Corbusier answers: "I'm not building any". There, he also offers Le Corbusier the fulfillment of one of his well-known visions. Then Le Corbusier reveals he's an architect, to materialize what he imagined and to ask for an exception from urban rules in force at the time (1950) according to statement of Pierre Hardy, a witness of meeting in Dautry's office, where was decided about a location of a new big condo building, Dautry presented Le Corbusier to Urban Cassan (an architect who was director of Ministry of urban planning and reconstruction and later head minister of state civil engineering) as "an architect known for building books (papers)". Allegedly, after the discussion Cassan suggested Marseille as a town "least dangerous" for building such a big construction.<sup>5)</sup>

As a minister of urban planning and reconstruction Dautry directed an official order on the 30<sup>th</sup> of November 1945.<sup>6)</sup> At the beginning of 1946 Le Corbusier already established ATBAT – "Atelier des Bâtisseurs" under the supervision of Andrea Wogenscky, administrative direction of Jean-Louid Lefebvre and with Vladimir Bodianski as a technical headmaster and Marcel Pye as a director of building sight tasks. The role of ATBAT was to make implementation project and implementation of construction of Marseille Unité. Since the beginning of 1946 it was being designed and perfected what has already been designed practically until construction of Unité in 1952. At that point, under the ATBAT, the project of reinforced concrete mega-structure was created.

2) In detail: Ivanković, 2006:104-115 [5]

3) Le Corbusier 1937:269, 271 [6]

4) It's sketch, more detailed than the first one in "Quand les cathédrales étaient blanches" with a comment about condo individualisation with sketches of two-stories condo, which has because of insolation importance – "sun is ruling over the condo" – foreseen height of the living room of 4,5 m. For the bedroom with a sufficient and economical height foreseen was 2,20 m (10 cm is the thickness of the reinforced concrete plate); Le Corbusier 1942:115-117 [7]

5) Sbriglio 1992:26-27. [10] it is interesting that Urbain Cassan was later known as a designer of the "Montparnasse" tower in Paris (1969-1972) with Reger Saubot, Eugen Beaudouin and Louis Hoym de Marien as cooperators.

6) Sbriglio 1992:27.-29. [10]

In the period from November 1945 to October 1947, when foundation stone was set, 4 locations for the building were changed.<sup>7)</sup> The first one was in industrial, north suburb La Madrague, the second one south next to Michelet boulevard, the third one Saint-Barnabe and the fourth and final again Michelet (on the west side of boulevard), that was also the best according to Le Corbusier both because of the building-free environment and because it was very close to boulevard that was the main axis, with specific "systeme de contre-allees") that was designed both with a street wide circa 45 meters in the 20<sup>th</sup> century as a continuation of big city Avenue du Prado from the 19<sup>th</sup> century.

It was the key element of urban structure of Marseille that was transforming the city from classic to modern, functional regional metropolis.

After the fourth location was chosen Le Corbusier suggested the possibility of constructing three more buildings (with two towers of a round floor plan) that would be situated according to conditions of ideal insulation. Earlier urban plan of Marseille drafted in 1949 included constructing series of unites and accompanying low buildings- educational, mercantile and service centers and malls – right next to new avenue that was planned to be situated vertically on south end of Michelet boulevard on the east-west side, southern than the place unite was built later. The plan Marseille-sud whose detailed drafts were dated on the 1<sup>st</sup> of January 1951 foresaw the construction of seven clusters (in total 24 unites) connected to fast roads in Cartesian grid of vast dimensions (in the relation to old Marseille). One of the roads would be already existing boulevard Michelet. There were foreseen seven "clusters" with three or four circular shaped towers. On the other hand, next to secondary roads there would be allowed only construction of low buildings of educational and service centers.

The building of Marseille unite and its final urban context was designed for years, parallel to constructing, and in that period Le Corbusier changed exterior appearance of the building, appearance of several construction elements and community balconies. He was also perfecting models of two-story apartments. The problem was that the structure was set from the beginning and only a few details were perfected, for example reinforced concrete consoles ("cassettes") – which was prolongation of the first reinforced concrete slab and served as a canopy for covering the entering part of building. Le Corbusier's first draft made for the first location Le Madrague differs from the building that was really built. First drafts originate from August 1945 and show three blocs-all three on columns, but without the development of Le Corbusier's unique concrete plastic, without specific organic forming of concrete in scaffolding. The building for the third location was a combination of the first three and the first residential unite building in the shape of big laid down prism set up on columns, still in classic

cubicle shape, both as the third and the fourth one that distinguish in details but following the conception of thin volume on reinforced concrete columns.<sup>8)</sup>

After it was built, there were 337 condos in 23 types in the building-from a hotel room to family condo for a family with 4 to 8 children with 5 bedrooms and living room with kitchen that was equal for all two-story condos. Condos were designed for a half distance between the columns on the ground floor because the structural distance between the upper columns was half the distance apart from each other. In literature, the type with 3 bedrooms with rooms upstairs or downstairs (depending on whether you go up or down from the foyer<sup>9)</sup>) is mentioned most often.

There were 4 units built in France till 1967: Marseille, Reze, Briey and Firminy. Each of them has similar typology of condos and similar bearing structure. Because of the economy the distance between the columns was made smaller and for the same reason the buildings also lost characteristic flagrant natural concrete. In Europe there were 5 unites - after 4 in France, there was one built in Tiergarten in Berlin, Germany.



*Figure 3 Condo building in Marseilles, photo from south-west side; FLC Vol. 8 1/19  
Slika 3. Višestambena zgrada u Marseilleu, fotografija s jugozapada; FLC Vol. 8 1/19*

#### 4 Reinforced concrete and concrete parts of the construction

##### Armiranobetonski i betonski dijelovi konstrukcije

Dimensions of the building: length 135,5 m, width 24,5 m, and height about 56 m. Width between the columns on the ground floor level is 8,38 m (16 spans), but the width between them in the upper stories is half the width above the ground - 4,19 m (32 spans).<sup>10)</sup> This way the bearing structure

7) After that, there were some changes in national politics. Communist Francois Billoux was set on Dautry's place on the 26<sup>th</sup> of January 1946 in conversations and correspondences with new minister and mayor of Marseille (both from the same political party), Le Corbusier manages to ensure further financing and construction of unite. About French political situation, Le Corbusier's lobbying for constructing and communistic government since the elections on the 5<sup>th</sup> of May 1947 that led to new communistic mayor's support to create Marseille as a "Center of advanced constructing", "place of experimenting and innovation" and to support Le Corbusier's model you can read more in Sbriglio 1992:41-45. [10]

8) Collection with drafts, sketches and project for the fourth location (Michelet) contains several dating errors: [11, 12]; Fondation Le Corbusier created digital collection with all drafts and projects for the period of 1055-1952 with familiar data, among which are also drafts and sketches for the building in Marseille. It also contains urban plans where the unite model was used as a new form of multi-condo building: Saint-Die (1945), La Rochelle la Pallice (1945), Saint-Gaudens(1945), Marseille Vieux-Port (1947), Marseille-Veyre (1949), Bogota (1950), Marseille-sud (1951) and Meux (1957); [13, 15].

9) Condo bigger than this has the same planar design with extra 2 bedrooms, i.e. another structural grid of 4,19 axially part. That is the largest condo in a building that Le Corbusier plans for a family with 4-8 children. Children's bedrooms are wide around 2 meters.

10) By the working plans [14]



changed from columns on the ground floor level, that are founded on separated foundations, into a set of bearing walls orientated transversally not to limit the design of the façade. The building consists of a ground floor and 17 stories with community balcony on the top of 17<sup>th</sup> floor, or 19 floors all together. 7<sup>th</sup> floor is characterized by inner street, with shops in the northern wing of the building, on the outside visible by two stories high concrete "brise-soleil". The community balcony on the last floor has a kindergarten, children pool, playground, clubs, gym, running tracks, sports centre, etc...

As transversal bearing construction the building has walls in between every column span and longitudinally there are two hallway walls stretching from the first floor up to the top, but on the ground floor level only columns and one reinforced concrete core are used for the horizontal stabilization of the whole building, almost 140 m long and 56 m high.

Staircase is not situated in the center of the building, but with a slight deviation. The building also has two additional reinforced concrete evacuation staircases and two steel stairs for fire fighters. These stairs are situated 44 m away from each other (22 m radius), which gives quite a complicated ground floor plan characterized by equally distributed bearing construction.<sup>11)</sup>

The only reinforced concrete bearing walls in the ground floor level are the walls of the staircase and the foyer, where the walls of the foyer were built separately and are bearing only self weight. Walls of the foyer are formed as well with wooden scaffolding, but the scaffolding for those walls was constructed out of carefully chosen high quality wood. Thereby the special and fine approach, defines Le Corbusier's work after the war, carried out for the first time on site in Marseilles.

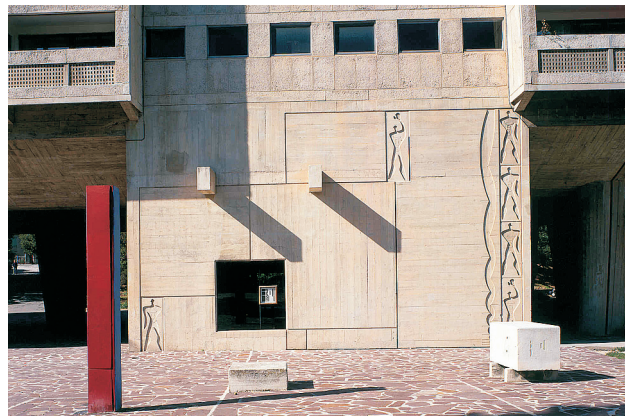


**Figure 4** Condo building in Marseilles, entrance; FLC Vol. 8 5/19  
**Slika 4.** Višestambena zgrada u Marseilleu, ulazni "kasket";  
FLC Vol. 8 5/19

Concrete in the ground floor is decorated with numerous Le Corbusier's symbols and ornament games – formed by geometrically placed wooden plates and other different shapes, used for the scaffolding, with scales from "Moludor" (combines author's interpretation of golden cut measures), to abstract shapes of a man, who symbolizes the start point of all measures in architecture and civil

<sup>11)</sup> The evacuation staircase leading from the inner street on the 7<sup>th</sup> floor is visible on northern side of the building. It is shaped from reinforced concrete made in situ.

engineering. These facts evoke Le Corbusier's ideas of humanistic orientations and points towards the final victory of art over engineering in his two sided attitude.



**Figure 5** Condo building in Marseilles, ground floor with unique sculptural treatment of concrete finishing works; FLC Vol. 8 6/19  
**Slika 5.** Višestambena zgrada u Marseilleu, prizemlje s jedinstvenim skulptorskim tretmanom završne obrade betona; FLC Vol. 8 6/19



**Figure 6** Condo building in Marseilles, community balcony model; FLC L1(12)37

**Slika 6.** Višestambena zgrada u Marseilleu, maketa zajedničke krovne terase; FLC L1(12)37



**Figure 7** Condo building in Marseilles, community balcony, about 1952; FLC L1(15)75

**Slika 7.** Višestambena zgrada u Marseilleu, zajednička krovna terasa, oko 1952.; FLC L1(15)75

The same principles were used on reinforced concrete elements of the community balcony, where the kindergarten is situated and shaped in a shape of an alone standing construction on the highest floor of the building, the



children's pool as well (finished with mosaic plates), as the elevator machinery and installations, oval shaped, as were the columns on the ground floor. Visual connection in between the ground floor and the community balcony on the last floor is a game of organic (but regular) shapes of the bearing construction – on the ground floor columns and over dimensioned elevator and ventilation shafts on the highest floor. The Marseilles building presented the biggest art interpretation of reinforced concrete of that time, primarily showing the bearing construction.

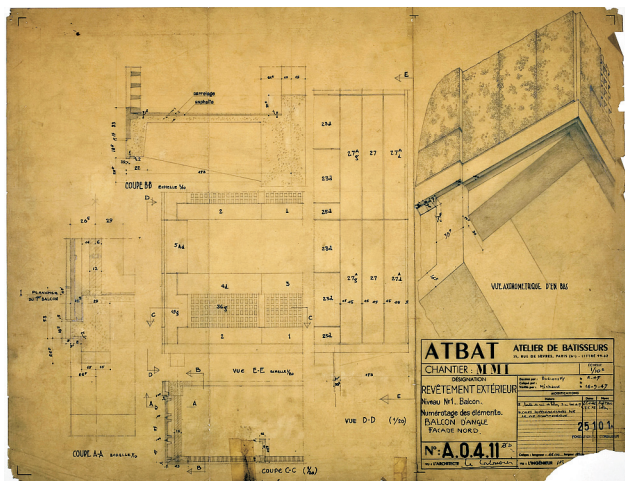
#### 4.1

##### Prefabricated concrete parts of the construction

##### Prefabricirani betonski dijelovi konstrukcije

The Marseilles building except for the bearing reinforced concrete construction consists also for prefabricated elements, which was quite advanced technology for the second half of 1940s since the recent war effected the building technology of that time. Prefabricated were stairs, landings, (metal stairs for firefighters, while evacuation stairs were monolith), balcony parapets and those of other building openings, concrete benches (which were covered with tiles) and numerous other concrete elements as those for closing of the installation shafts on the ground floor level.

Prefabricated were also some kind of light openings on the ground floor level, and concrete *brises-soleil* (especially visible are those two stories high on the 7<sup>th</sup> floor used to close up the inner street) looking like an extension of reinforced concrete construction. After Le Corbusier used those details, they set the trends of that time from 1950s.<sup>12)</sup>

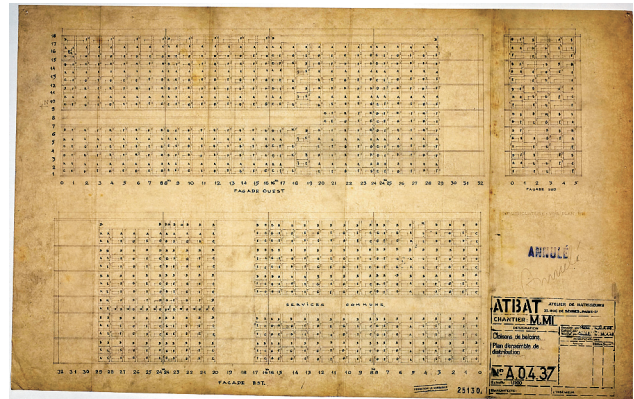


**Figure 8** Condo building in Marseilles, executive plan, balcony, level 1, prefabricated elements of the structure – numeration of construction elements; FLC 25101A

**Slika 8.** Višestambena zgrada u Marseilleu, Izvedbeni projekt, balkon, nivo 1, prefabricirani elementi konstrukcije – numeracija konstruktivnih elemenata; FLC 25101A

<sup>12)</sup> For example, Croatian architect Drago Galić was among the first of Le Corbusier's followers designing the multi-condo buildings. His buildings in Vukovarska street 35, 35a i 43, 43a in Zagreb, built during the years 1952-1959, were designed completely after the inspiration of Marseilles type. While designing Galić is quite original, especially with his communication concept in plan typology of condos and with building shapes which are shaped like laid down prism set up on large columns. Numerous details of concrete design are original and are shaping unique Croatian esthetics of natural concrete typical for Europe during the 1950s. More details [16].

In relation to Le Corbusier's tendency towards concepts of building possibilities with a new material, the vision of a building that is set together, like a ship, somewhere on an imaginary building dock was quite unimaginable.



**Figure 9** Condo building in Marseilles, executive plan, balcony spandrel – distribution plan of balcony spandrel, façade E-W, S; FLC 25130A

**Slika 9.** Višestambena zgrada u Marseilleu, Izvedbeni projekt, balkonski parapeti – plan rasporeda balkonskih parapeta pročelja istok, zapad, jug; FLC 25130A

#### 4.2

##### Installation positions

##### Pozicije instalacija

Installations of the building solved very rationally, which enabled standardization and rational placement of sanitation vertically. All main horizontal installations lines (main electricity distribution, plumbing and sewage) are placed within a hollow space between the ground floor and the first floor, the so called artificial floor ("sol artificiel"). The horizontal installations are distributed through columns to the installations in the ground. The shafts are 2 m and 9,5 cm high, entered over service ladders beneath the plate of the first floor.<sup>13)</sup> Vertical installations are placed by the reinforced concrete columns covered with prefabricated elements to give a feeling that they are within a monolith of a column. Service is done by simply removing the prefabricated element and afterwards having it placed back.

After the main installations are distributed through the columns from the ground to the artificial floor, they are distributed through the "floor" to the needed vertical position, and afterwards beneath the façade of the 8,35 m long walls to condos. Since the constructive gird in the upper levels is half the width of the distance of columns on the ground floor level, the necessity is that every second wall at the upper levels contains installations. This is the reason that condo plans are mirrored according to the longitudinal axes of their bearing walls. Some walls are used for sewage distribution to the foundation level sewage. In the case of sewage there was no need in distributing it through the artificial floor, but it was distributed under 45° through the walls to the main sewage pipe beneath columns to the ground sewage.<sup>14)</sup>

Electrical installations were distributed by the same schematics, after the horizontal distribution through the

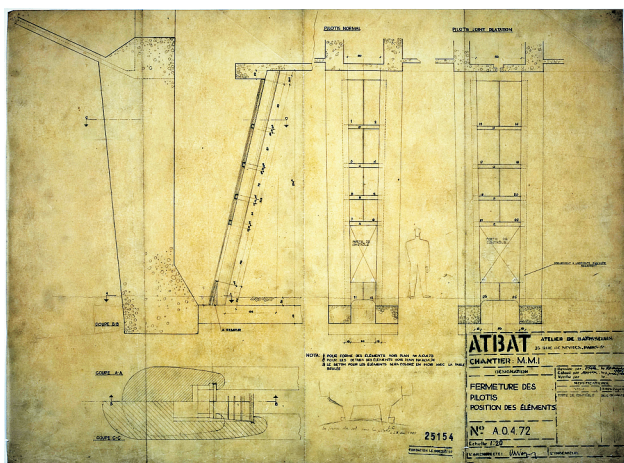
<sup>13)</sup> Cross section "A-A" from working plans, ATBAT, FLC-26274

<sup>14)</sup> Cross section from working plans of plumbing and sewage, page nr. T.2.8.9, FLC-26210, and T.2.8.20-29; FLC-26218-26227



artificial floor, through every wall of condos over the bearing walls (over every column and on the half width between them).<sup>15)</sup>

The building is equipped with fire fighting system ("système incendie", sprinklers system) with two reservoirs. One of the two was situated beneath the building with a pump, containing 400 m<sup>3</sup> of water and the second one on the highest point of the building over the reinforced concrete elevator machinery containing 100 m<sup>3</sup>. System was distributed within every community room and every condo.<sup>16)</sup>



**Figure 10** Condo building in Marseilles, executive plan, closing of installation shafts on columns on the ground floor level – element position; FLC 25154

**Slika 10.** Višestambena zgrada u Marseilleu, Izvedbeni projekt, zatvaranje otvora za instalacije u stupovima prizemlja – pozicije elemenata; FLC 25154

## 5

### Conclusion Zaključak

The invention of reinforced concrete of Auguste Perret and advanced concrete prefabrication by Jean Prouvé, were taken over by Le Corbusier as technological aim of condo building during the 1950's. In his scope of work Unité presents his first one and a crown jewel of great success, where the prestigious perfection was almost achieved. In that paradox combination of techniques where the prefabrication was created for using on different construction sites, but on the other hand great amounts of finances and time were used to shape precisely unique details of scaffolding and its complicated production. The technology for itself was unique and never again used concept of Le Corbusier, which he developed beginning with the first worldwide known designs "Dom-ino" from 1914 and "Cirohan" from 1920.

Since those first designs until the end of 1940's, when the composition of "Unité" begins, the manufacturing of buildings was almost on the same technology level. (Even today the works are organized and conducted by the specific needs of every building site. The need for low qualified workers is even today still high.) For the first time in the

history of architecture, standardization, prefabrication and precise production of concrete in situ, which is technologically completely different from industrial production, resulted with perfect final shape, acting as one inseparable piece – like a concrete giant shaped in a perfect big scaffolding or sculptors foam.

Additionally painted side walls on balconies of condos in 4 basic colors symbolize simplicity, honesty and originality of the builder. Perfection of the community balcony that has kindergarten, clubs, runways, over dimensioned elevator machinery and ventilation shafts, which had not only constructional, but also esthetical function, reveals several explicit, at first sight visual connection between an overseas ship and that condo building. That was a technological inspiration and an announcement of future building away from the building site in specialized production facilities.

A building built in the technique described and analyzed in this article, was designed with this complexity, with recognizable perfectionist approach, because of the architect's ideas of mass education of workers, advancement of knowledge and basic technical knowledge, also because of living style of the working class, that in his visions, had to have high cultural interests. All of these facts can be concluded from all the circumstances that followed the construction of Marseilles "Unité", shown in this article.

Designing solutions, where plans of condos with specific double gallery height of living rooms are probably less important than the solution of construction itself, and also more important than still applicable solution of installation implementation in "hidden" part of a building, can serve also as a model to contemporary designers. That is especially important for anticipation of originality and architectural authenticity of the projects whose external parts are almost completely exchangeable. And that was – like in the case of "Cirohan" project from 1920 too - in the spirit of avant-garde solutions of car industry of the 50's. It's not excluded that some new building, "floating" above the ground would also have complex system of hydro-pneumatic design system, whose comfort, like the one in building in Marseille called "Unite d'habitation de Grandeur conforme" importance would go beyond everything else, even the complexity of mechanism and price of one completely untypical construction. It was Le Corbusier's technical solution marked by junction of the best prefabrication and the best in situ performance and constructing on columns.

Final result in building shaping was also one new visual junction-connection of concrete and nature. That was a stylistic game of light and shade in dramatically expressed plastic of massive ground floor columns, ruled by harsh Mediterranean sun and esthetic impersonation of new shapes, which explicitly reject puristic ideas of reinforced concrete constructions of 20s, which have to be seen the way they are, the way they are functioning. In conclusion, development of Le Corbusier's designer principles is marked by stylization of construction and the use of modern ornament, which was different from functionality principles in architecture, insisted on in the 20s. It is possible that the final appearance was the result of a few decades of architect's work on development of building technique of concrete, scaffolding and prefabrication. On the other hand it's clear that it's a product of passionate junction of artist and concrete that inspired architecture of the 50s and speeded up world development and use of constructions that marked second half of the 20<sup>th</sup> century.

<sup>15)</sup> Working plans for electrical installations, page nr. T.3.0.1-T.3.1.10, FLC-26236-26257

<sup>16)</sup> According to schematics for fire fighting and technical description for fire protection, page nr. T.2.9.2, FLC-26235

## 6

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