ARCHITECTURES OF BEIRUT, 1925-1970

Restoration Manual

éditions AL AYN
مبادرة بيروت للتراث
BEIRUT HERITAGE INITIATIVE
Fondation de France

This manual is published in the collection "Cahiers d'architecture"

Copy editing: Nadine Harake
Graphic design and layout: Dounia Habache
Printing:

ISBN: 978-9953-0-5808-5

2022
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ARCHITECTURES OF BEIRUT, 1925-1970

Restoration Manual

under the direction of Fadlallah Dagher

For Beirut, a wounded city, its dwellers and its houses

In memory of Robert Saliba and Habib Debs

Claudine Abdelmassih is an architect (Ecole d'Architecture Paris-la-Seine, 1997) living and working in Beirut. Claudine is an academic and lecturer at the University St. Joseph (USJ) in Beirut, where she works in the departments of Geography and Architecture (ECAR). Between 2012 and 2020, she was a board member and project manager at the Arab Center for Architecture (ACA), an NGO aiming to raise awareness about architecture and urbanism in the Arab world. Abdul Massih is the author of the "Guide to Accessibility for People with Disabilities," which was published by MAJAL in collaboration with APAVE Lebanon, the Order of Engineers and Architects and the Lebanese Union for People with Physical Disabilities.

Naji Assi graduated from Académie Libanaise des Beaux-Arts (ALBA) in 1994 and received his C.E.A.A. *Villes Orientales, Maghreb et Proche-Orient* from the Ecole d'Architecture de Paris Belleville (EAPB) in 1996. He was managing partner at SA47-Sabbag Assi Architects until 2013, where he conducted several new development and restoration projects in down town Beirut. In 2013, he founded Naji Assi Architects with a focus on rehabilitation and restoration projects. Since 2004 he led a workshop entitled Surveying Regional Architecture at the Department of Architecture and Design at the American University of Beirut (AUB). Assi collaborates with several institutions and NGOs (DGA, ACA, NAHNOO, BBHR, BHI, BEYOND) with a focus on built heritage and public spaces.

He also collaborated on the following publications: "L'Homme, La Terre et La Pierre" Fondation Nationale du Patrimoine, 2001; "Towards a Better Built Environment" General Directorate of Urbanism (DGU), 2003; Restoration Guidelines Manual for buildings constructed between the 1930s and the 1970s, Arab Center for Architecture, Amman Design Week, Goethe-Institut, 2021.

Fadlallah Dagher is a Beirut-based architect. Along with his firm, Dagher Hanna and Partners, he has designed projects covering various building types, including historic building renovations. Dagher has taught at Académie Libanaise des Beaux-Arts and the American University of Beirut. He has been a member of APSAD since 1992, and was previously an advisor to the Minister of Culture for the protection and conservation of heritage buildings in Beirut. Following the August 4, 2020 explosion in Beirut, Dagher has joined efforts with colleagues and professionals to launch the Beirut Heritage Initiative. He has directed the publication of "L'Homme, La Terre et La Pierre" (Fondation Nationale du Patrimoine, 2001), and has contributed to Beit As-Saifi: As Time Goes By (Marc & Hala Cochrane, 2015).

Fadlallah has been the Dean of the Académie Libanaise des Beaux-Arts since September 2022. (ALBA - University of Balamand).

Yasmine Dagher is an architect based in Beirut. Her passion for Beirut and its architecture pushed her to further her education with a Master's degree from the Academie Libanaise des Beaux-Arts (ALBA) centered on heritage preservation and city development. She was one of the first volunteers to join the Beirut Heritage Initiative. She is currently the Docu-Comm Manager and has participated in numerous workshops on the rehabilitation and preservation of traditional (1860-1925) and modern heritage (1925-1970).

Yasmine El-Majzoub holds a bachelor's degree in Architecture from the American University of Beirut (AUB). Working with architecture firms in Beirut over the years has helped her identify and pursue her interest in heritage preservation, sustainable design, and participatory design. Her growing interest and fascination with built heritage and vernacular architecture led her to participate in restoration and conservation workshops in Italy and Morocco. Yasmine was fortunate to be a volunteer with Beirut Heritage Initiative from the beginning and now manages the Field and Operations team, coordinating with various stakeholders involved in the restoration projects.

Mazen Haïdar holds an MPhil in Architectural Conservation from the University of Rome La Sapienza and a PhD in Architecture from Université Paris 1 Panthéon-Sorbonne with "The reception and appropriation practices of modern architecture in Beirut" as a subject. As a practicing architect, he led and participated in several conservation and adaptation projects of 20th century buildings in Lebanon. He currently teaches at the École Nationale Supérieure d'Architecture de Paris Malaquais. Among his last publications *La Ferronnerie Architecturale à Beyrouth au XXe siècle* (Paris : Éditions Geuthner, 2021).

Rodolphe Mattar, the founder of Bureau d'Etude Rodolphe Mattar - BERM, is a driven individual who is passionate about everything engineering (1979). BERM is an engineering firm that has completed over 2,000 engineering projects in the Middle East, Africa, Asia, and Europe. In his 40+ years of academic profession (ALBA, ESIB, ULFG2) and 50+ engineering experience in the structural design and consultancy field, Mr. Mattar has conceived and designed a wide variety of building structures from ordinary to challenging buildings, from low to high rise buildings, from heritage to new buildings. His consistent and successful achievements have established him as a first-class reference in the field of structural design engineering, having worked on a variety of projects including the Sky Gate Tower, the University of Balamand, the World Bank Headquarter - Rehabilitation and Retrofitting (BCD), the Le Grand Theatre - Rehabilitation and Retrofitting (BCD), and others.

Selim Merhej has more than twenty-eight years of experience in civil and structural engineering in Lebanon. His current position as Technical Director at Bureau d'Etudes Rodolphe Mattar entails civil and structural engineering consultancy, including the design of various types of building structures (ancient and new) in Lebanon, the Middle East, and Africa, in accordance with American and European standards and codes. His duties involve site inspection and supervision, the elaboration of specifications, BOQs, cost plans, contract documents, and multi-disciplinary coordination.

Aram Yeretzian has over 30 years of experience in designing climate responsive architectural projects and masterplans. Aram has worked as an assistant professor with a joint position for climate responsive buildings at the American University of Beirut since 2015. His teaching and research focus on climate-responsive architecture and construction materials that have low environmental impact. He investigates the relationship between building behavior and human behavior in specific climate regions. Aram is a member of the Sustainable Buildings Committee at the Order of Engineers and Architects in Beirut. He is a founding member of the Lebanon Green Building Council and as its president from 2012 to 2014. Finally, Aram speaks at sustainability conferences, serves as a jury member at several universities, and represents the Ministry of Environment in issues concerning the environmental aspects of buildings. Aram enjoys going for walks in nature, as well as painting and sketching.

Georges Xanthopoulos is the head of the Accessibility and Rehabilitation Program of arcenciel; Lebanon's largest independent social enterprise. arcenciel was awarded "Social Enterprise of the Year" by the Schwab Foundation, organizers of the World Economic Forum in Davos (2015), and the first Takreem award laureate (2010), among other honors. Georges was a key player in the passage and implementation of Law 220/2000 in Lebanon; he was a team member in the drafting of the Law 220/2000 on the Rights of People with Disabilities, an elected member of the National Committee for People with Disabilities since 2001 and for five mandates, and a member of the national committee for the development of the Lebanese Accessibility Norms. Georges was born and raised in Beirut. He holds a degree in Civil Engineering from the Université Saint Joseph (USJ).

TABLE OF CONTENT

INTRODUCTION

Fadlallah Dagher

After deadly explosions rocked the Port of Beirut on August 4th 2020, the Beirut Heritage Initiative (BHI) was established with the sole aim of revitalizing the destroyed neighborhoods by rehabilitating their built heritage. It is in the neighborhoods of Medawar, Rmeil, Saifi, and Ashrafieh that most of the buildings of the late nineteenth century that survived the real estate boom from 1990 to the present day are concentrated. The building techniques of Beiruti houses erected at the end of the Ottoman era were the subject of the first restoration manual, published in August 2021 by the BHI with the support of the Fondation de France and the assistance of many experts. [1]

Beirut's urban heritage should not be limited to the "triple-arched Beiruti houses" of the Ottoman era. Buildings designed between 1925 and 1970, or during the French Mandate and the post-Independence years, occupy a significant part of the capital extending from its center to its peripheral districts. Built mainly with the advanced techniques of Portland cement and reinforced concrete, these structures testify to Lebanon's commitment to a modernity that helped place Beirut at the forefront of change in the Middle East. The urban landscape of the city continued to change and expand over the span of the next four decades extending from the birth of Greater Lebanon to its Independence and the subsequent era dubbed the "Golden Age" of Beirut (i.e., the 1950s and 1960s). For a while, this transformation coincided with the persistence of the "triple-arched house"," to create a half-organic, half-planned Mediterranean urbanism of pretty neighborhoods and private gardens. This unique mesh was soon interjected by large vehicular roads and high-rise buildings that slowly replaced many features of the old fabric.

Beirut's modernization came to a grinding halt some fifty years ago, with the advent of the Lebanese civil war. Ever since, the city —along with the rest of Lebanon, for that matter— remains stunted. Its obsolete master plan, drawn up in the 1950s, has not been revisited so as not to thwart the greed of an unbridled capitalism that sees businessmen, politicians, and opportunists, ally with no concern for the well-being of a population being marginalized and forced into exile. Following the same logic, there has not been a single legal framework that defines, frames, or protects Lebanon's built heritage (apart from the Law of Antiquities expounded in 1930!). Thus, the districts of Beirut continue to suffer the disappearance of century-old houses at the hands of an unforgiving modernization process that dooms all traces of the past era to erasure...

Let us not lament, however. This second manual, published with the support of the Fondation de France, describes the various typologies and technical characteristics of modern architecture in Beirut. It is aimed at professionals, architects, engineers or urban planners, as well as untrained partners, such as the inhabitants themselves, to help them identify Beirut's more recent heritage and urge them to preserve its character –especially during restoration work. This includes not only describing Portland cement-based building techniques, which are still widely spread and documented, but also providing a guide to the composition of elements, their hierarchy, and the simple and sustainable industrial materials with which the first generation of engineer-architects from local and international schools expressed themselves on practical and aesthetic levels. The manual also discusses architectural upgrades like the addition of modern infrastructure to these buildings, and their adaptation to new uses, as well as strategies for their preservation within the framework of an urban vision.

Since August 4, 2020, NGOs, volunteers, and activists have worked admirably to restore urban life, despite municipal and state authorities' passivity and indifference..

A special thanks is due to the manual's authors, whose invaluable contributions to this work help preserve Beirut's memory.

[1] *Houses of Beirut 1860-1925. Restoration manual.*
Collection Cahiers d'architecture. Editions Al Ayn. 2021.

Link : www.beirutheritageintiative.com/restoration-manual/

DEVELOPMENT AND TRANSFORMATION OF BEIRUT ARCHITECTURE BETWEEN 1930 AND 1960

Mazen Haïdar

1

2

Concurrent with Beirut's expansion and densification, the buildings of the period 1930-1970 comprise a diverse heritage in the city. If the French Mandate was marked by the introduction of new construction techniques, Lebanon's Independence is marked by strong economic growth and significant development of the real estate market. The densification of the capital began in the first ten years of the twentieth century, with new constructions optimizing land use. The individual house model is gradually abandoned in favor of four-to-five-story vertical structures. This urban densification is also manifested by the raising or total demolition of existing buildings in favor of apartment buildings, a model that is becoming increasingly dominant.
The massive use of reinforced concrete in the 1920s and 1930s was reflected in residential architecture by a gradual reconfiguration of the volumetry and facades of the Beiruti building (1). The triple arch that characterizes late Ottoman architecture is gradually simplified into one or more rectangular openings while the red-tiled roof fades into the cityscape. Aside from their site adaptation, buildings from the French Mandate period are distinguished by increasingly generous outdoor spaces. While balconies were traditionally reserved for the large living room or central hall, corbelled balconies are now appearing in other rooms of the apartment. This new reinforced concrete technique also allows for the creation of self-supporting verandas, which are transformed into a separate living area that Beiruti citizens largely appropriate (2). The central hall plan, on the other hand, represents the main constant between Ottoman heritage and French Mandate. Until the mid-1940s, the centrality and symmetrical partitioning of the interior space were clearly reflected on the facade by an organization punctuated by openings on a vertical axis. The alignment along the streets imposes itself as a result of urbanization, as does the introduction of new typologies of residential complexes. Other solutions emerge at the scale of the building as more interior space is saved, such as bay windows projecting from the building envelope.

Vertical growth characterized the development of residential buildings in the following decades, as land prices rose and central districts became more crowded (4). The increase in rental investment paves the way for the growth of investment property as a primary source of profit. With the legislative decree n°61/LE of August 30, 1940, followed by the law of January 20, 1954, construction activities are within a legal framework that accompanies the evolution in terms of building height and footprint regulation.

However, the story of Beirut's constructive dynamic during the Independence period goes far beyond the issue of land exploitation. Many architectural historians agree that Lebanon's "modern period" is the result of the country's liberal economic system as well as a significant development of the construction trades. The residential, or tertiary project, begins to spread the culture of a new generation of Lebanese or Arab architects-engineers with the emancipation of the aesthetic of the colonial period. Imbued with the rationalist principles of the "Modern Movement", these professionals can rely on upper middle-class project management, seduced by any novelty in the world of construction. Farid Trad (1901-1969), Rodolphe Elias (1907-1999), Antoine Tabet (1907-1964), Saïd Hojeil (1910-1996), Nadim Majdalani (1914-1978), George Rais (1915- 2002), Ferdinand Dagher (1921-2004), and Joseph-Philippe Karam (1923-1976) are among the pioneers whose achievements are multiplying in Beirut and Lebanon. Even though some Art-Deco elements can still be found in the Beiruti building, the architecture of the 1946-1955 period introduces new composition principles. Aside from the day/night distribution of apartments in residential architecture, there is also a pronounced horizontality on the facade, new types of treatment and coatings, enveloping outdoor spaces, and increasingly large glazed surfaces... These new characteristics are beginning to distinguish buildings in many sectors, including Hamra, Raouché, Sioufi, the Park sector, Ras al-Nabeh, and even certain peri-central districts like Kantari. The preservation of buildings from the French Mandate or Ottoman period in close proximity to modern projects helps to highlight the architectural novelty while emphasizing the image of obsolescence of older building residents.

The history of construction in Beirut can be traced back to the tension that develops over time between an architecture that is considered obsolete and an increasingly appealing modern production. The cycle of building transformations from 1950 to 1970, in turn, sheds light on certain changes in society and the development of the country's building industry. The variety of rehabilitation operations and additions to modern buildings serve as a reminder that the capital's built history can be told through its evolution, rather than just its initial stage of construction. One of the first categories of transformation is the conversion of the first levels of residential buildings from 1940 to 1955 into commercial spaces. The Arida building (Sanayeh sector), built by Georges Rais in collaboration with Théo Kanaan in 1949-1951, is a pioneering example of local modernism that attests to this evolution.

3

4

The implementation of the city's master plan, which immediately became a tool facilitating, even encouraging, densification and heightening of existing buildings, aided the search for improved rental profitability beginning in 1954. The city of Beirut is organized according to a radio-concentric logic in which the authorized building densities gradually decrease as one moves away from the city center [1]. The Abdel Baki building embodies this transformation, having been built in 1946 and raised around 1954 by architect Sami Abdel Baki (5, 6). The gradual addition of five floors to the original construction, as documented in several photographs, coincides with the implementation of the city's master plan. The decision to use the same formal language in the raised parts is betrayed by new floor heights – the 1954 construction law lowering this height from 3.30 to 3 meters [2]. This measure, which modifies the forecasts of the former legislative decree of 1940 [3], causes a break between the two phases of construction in most heightened buildings by manifesting itself on the façade in a more or less perceptible way. Many owners are compelled to begin transformation work during major heightened projects in order to “modernize” the building. Thus, the new construction techniques are systematically imposed on the entire construction. A building in the Horge district provides an provides a good example in this regard: embedded in a permanent structure from the 1920s, the new four-story project reconfigures the old corbelled balcony and standardizes the entire structure . The rapid mutation of aesthetic norms, combined with easy access to building materials, places 20th century architecture in Beirut in a cycle of continuous change, on a more or less large scale, that only appears to slow down with the outbreak of the Lebanon war in 1975, and the beginning of the long chapter of spontaneous repairs and reconstruction.

[1] Municipal Council Decision No. 70 of August 31, 1954 promulgated by Decree No. 6,285 of September 11, 1954 on the division of the city of Beirut into zones, with limitation and regulation of each of them.

[2] Cf. Article 20 of the Construction Law, 20 January 1954.

[3] Legislative decree n°61/LE of August 30, 1940 on building regulations in Lebanon.

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6

TYPOLOGIES AND CONSTRUCTION TECHNIQUES

Naji Assi

The period that followed the declaration of the State of Greater Lebanon in 1920, with Beirut as its capital, was marked by a strong French influence on many architectural and urban aspects.

The modernization of the port of Beirut and the establishment of the first cement factory in Lebanon in the late 1920s represented a significant change in the construction industry, allowing the importation of various construction materials and the widespread use of reinforced concrete.

The integration of this new material into domestic architecture freed the space from several constraints that existed in the previous decade, such as the span limitation of the thin solid slab (one layer of reinforcement) resting on I beams (limited length) and bearing masonry walls.

Reinforced concrete columns, beams and slabs were combined to form a three-dimensional rigid structure with infills in-between constituting the partitioning of the space (sandstone, brick, cement blocks) (7).

In parallel, the modernization of the city and the densification of the peripheral areas had introduced important changes to the typical central hall plan inherited from the late ottoman period. The kitchen and bathrooms acquired more importance and became essential amenities to the house. Hence a stronger need to separate reception spaces (day-public) from living rooms and bedrooms (night-private). This situation enabled engineers, architects, and builders to experiment either by reinterpreting with concrete traditional forms, or by innovating with the new material along the entire spectrum of the architectural language (curved facades, curved balconies or stairs, exposed structure, etc.) (8).

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Architectural composition

- Continuity with the traditional central hall house (in various scales) in which we still read the central bay as a central element flanked by lateral or peripheral rooms. Symmetry is often emphasized by projecting balconies or verandas as an extension of the central hall. In other cases, symmetry along the central space is attenuated by the introduction of the staircase (9, 10, 11).

- In some cases, we start reading the beginnings of an innovative modern plan with segregation between public and private spaces. We observe asymmetry and a volumetric composition articulating the connection between the different elements.

Proportions

- Despite the introduction of reinforced concrete as a new structural material, the ratio between mass and openings is still marked by a majority of mass punctured by openings with the exception of the central bay that opens it up towards its balcony or veranda.

- We notice a slight decrease in the floor to ceiling height which directly affects the proportions of openings that become squarish or horizontal rather than elongated.

10

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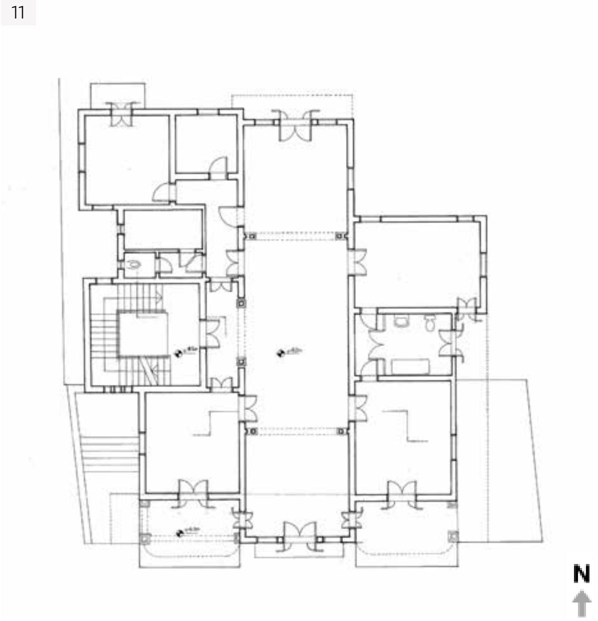

Technical details

- The beginnings of reinforced concrete are characterized by a limited knowledge of the performance of this new material. Dimensions and thicknesses of slabs, columns, and beams, are sometimes based on empirical considerations. Older structural elements like columns, beams, and slabs, are replicated in concrete with an effort to reproduce the decorative features inherent to those elements (pedestals, capitals, cornices, corbels, etc.), with the use of molds (12).

- Composite structures: In many cases where the principle of densification and addition was occurring, reinforced concrete was combined with other bearing materials such as limestone or sandstone (vaults, arches, walls), wooden and steel beams (13).

- The limited types of steel reinforcement (smooth bars) of this era imposed limitations on spans, cantilevers, and column sizes. In some cases, when acceptable spans (for slabs) or heights (for columns) are exceeded, slab deflection or column buckling can be observed with the naked eye.

- The simple handling of concrete on site (in comparison to modern techniques) and the limited concrete cover around rebars constituted a weakness that caused several pathologies during the building's lifetime.

12

13

During this decade, that culminated in the Independence of the Lebanese Republic in 1943, a strong French influence, especially of the Art-Deco movement, had spread throughout the cultural and artistic disciplines, including architecture, design, furniture, and so on (14, 15). Under the French Mandate, Beirut became a strategic city punctuated by several French military barracks. Its modernized port with its newly established free zone (1936), allowed a direct connection between the Mediterranean and the larger colonial territory of Lebanon and Syria [1].

During this period, Beirut underwent major urban transformations as a result of two major master plans launched within a ten-year period: The Danger plan of 1931 and the Ecochard plan of 1941 were both inspired by French laws promoting a more hygienic way of life in both public and private spaces. The proposed regulations touched upon several aspects of the urban and social fabrics like the streets network, aesthetics, and health [2]. According to the Danger brothers, Beirut had to respond to the requirements of functionality and efficiency of a modern city; It should be well connected to other major cities (Damascus, Tripoli, Saida), and have a network of internal streets connecting its different neighborhoods, despite the chaotic built fabric and its complex topography.

The above mentioned changes occurred concurrently with the city's expansion along its main arteries and a vertical densification process facilitated by administrative and regulatory reforms and accentuated by the spread of new construction techniques, particularly reinforced concrete.

[1] Verdeil, Éric. *Beyrouth et ses urbanistes : Une ville en plans (1946-1975).* Beyrouth : Presses de l'Ifpo, 2010. Web. <http://books.openedition.org/ifpo/2101>

[2] Ghorayeb Marlène. *L'urbanisme de la ville de Beyrouth sous le mandat français.* Dans : Revue du monde musulman et de la Méditerranée, n°73-74, 1994. Figures de l'orientalisme en architecture. p. 327-339.

14

15

Architectural composition

- Transition from the traditional central hall house and the composite layout based on the combination-separation of two types of spaces. Primarily the "dar," or reception space, which is still oriented north on its long axis and retains the inherited central bay, but with a series of formal and geometric variations that incorporate the freedom offered by concrete (16, 17, 18). Secondly, there are the more private spaces, which are comprised of the bedrooms and are accessible via a corridor connected to the entrance.

- This functional segregation creates somehow a kind of asymmetry in the volumetric arrangement which is emphasized by elongated cantilevered balconies defying gravity and introducing new forms with their curved outline (19).

- In the case of vertical expansion, additional floors are added on top of older structures, either in line with the existing building footprint or by expanding the floor area and then adding several upper floors. Verandas supported by concrete columns are often used a horizontal and vertical expansion device. Geometric forms, angular chamfers, vertical grooves, projecting cornices, etc. are part of a wide array of architectonics giving buildings a new character marked by diverse Art-Deco influences.

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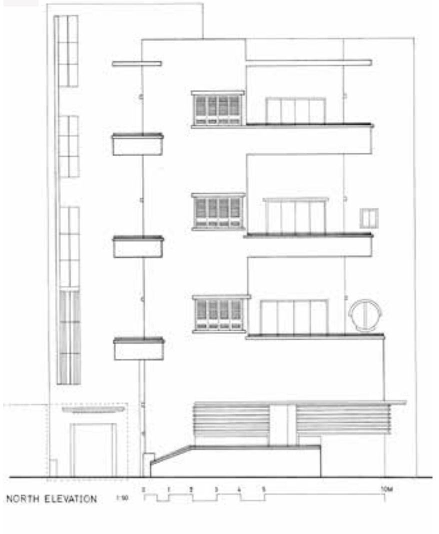

North Elevation

17

Ground floor plan

18

Apartment floor plan

19

Technical details

- Reinforced concrete starts acquiring its own character and presence on the various building components. Dimensions and thicknesses of slabs, columns, and beams, are standardized based on transmitted knowledge from engineers to contractors and builders. Structural elements like columns, beams, and slabs, are synthesized into simple geometric concrete elements with reminiscence of some decorative features inherent to those elements (pedestals, capitals, cornices, corbels, etc.).

- Structural elements v/s Filling elements: many buildings from that period can be distinguished by the concrete structural grid (columns, beams, slabs) and the remaining masonry panels that close the grid cells. This is often driven by an effort to reduce the cost of construction whereby masonry walls are thinner than the structure, hence revealing it on the outer or inner skin of the building (20, 21, 22). Reinforced concrete is combined with prefabricated concrete blocks used as masonry.

- The proliferation of concrete redefines secondary elements such as balustrades, parapets, and fences that were previously made of wrought iron or steel. However, despite the drastic change in materiality, concrete balustrades kept a relative notion of a ventilated barrier regardless of its shape which spanned from simple hollowed geometric forms to intricate molded thematic shapes (floral, musical, etc.)

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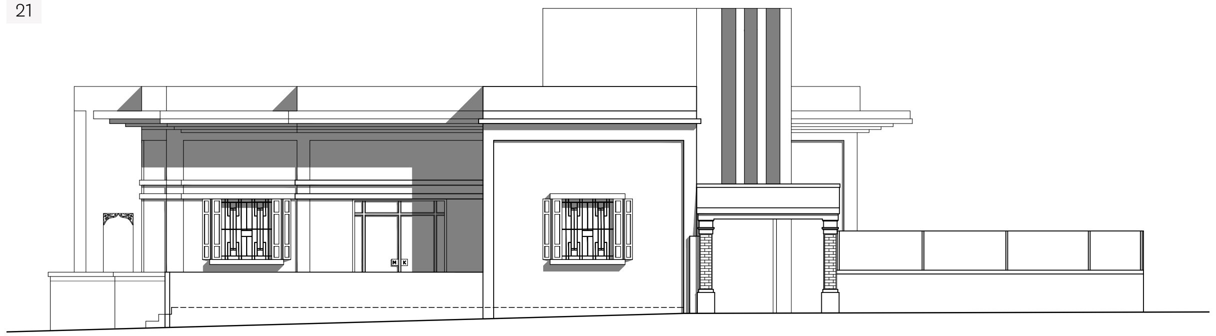

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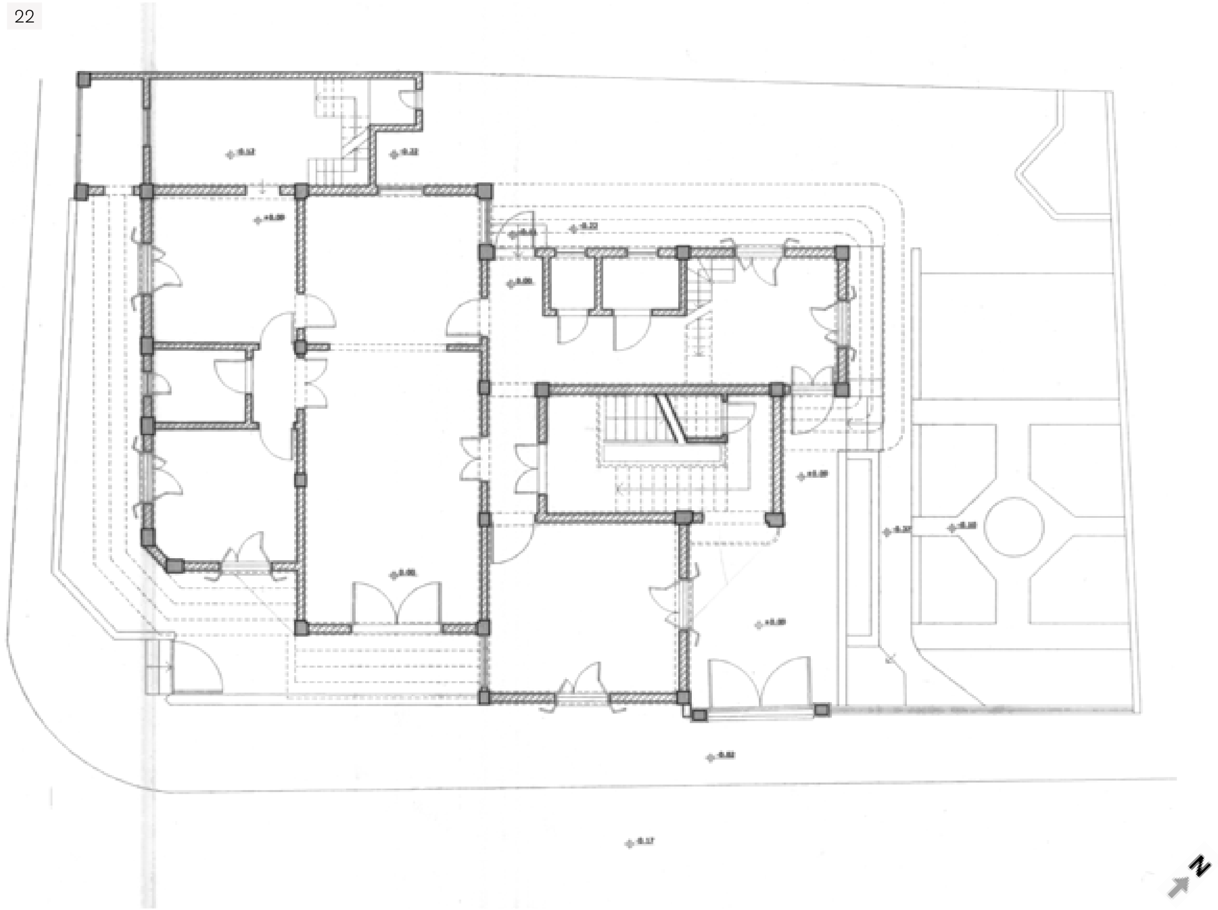

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During the post-Independence period, and following the establishment of a new regulatory framework based on the Ecochard master plan, Beirut enters the modernist era on both the urban and architectural scales. Zoning and exploitation factors, height limitations, pilotis floor, and special regulations for buildings taller than forty meters are some of the factors that contribute to a paradigm shift in the urban realm. Several avenues, boulevards and peripheral roads define the new network of the city, adapting to the increasing number of vehicles and cutting through the dense fabric of older neighborhoods.

The port expands further to the East and connects to the hinterland through the new coastal highway connecting Beirut to the North.

The functionalist master plan separated the city's different quarters and gradually densified the refugee camps on the city's northern and eastern outskirts. The Armenian quarter (today's *Medawar-Karantina*) is to the northeast, near the port; Marash (today's *Burj Hammoud*) is to the east, across the Beirut River.

The above transformations occurred in parallel with an expansion of the city beyond the peripheral boulevard (*Corniche El Nahr, Mazraa*) towards the southern sand dunes (today *Tarik el Jdideh)* and the southeastern outskirts of *Furn El Chebbak* along Damascus road.

Architects and engineers were instrumental in the spread of modern architecture; one striking example is the Badaro neighborhood, which was built on the ruins of a previous French military barrack. In other quarters of the city, modern buildings replaced older fabrics creating a sudden change in the scale and the morphology of the city (23).

Architectural composition

- The primary orientation of buildings becomes intimately connected to the urban form, specifically the street network. The apartment, part of a multi-storey building, adopts a more elongated plan with balconies overlooking the street (24). The dynamic configuration of the plan is also in line with the functionalist layout separating public spaces from private rooms. The latter are either assembled in a separate cluster that expresses itself as a relatively closed volume, or arranged in a row extending the linearity of the reception-dining space and sharing the same long balcony.

- The early modernist period is rich in architectural solutions for corner parcels, including the recurring curved volume with concave or convex outlines (23). In other cases, it is rather a relatively closed volume punctured with openings and operating as a transition between the two sides of the parcel (25).

- The commercial building becomes the dominant type with shops on the street level and apartments on the upper floors. In this configuration, the staircase acquires more importance and is integrated in the volumetric reading of the building. In many instances, stairs become the architectural key note around which the volumetric composition is articulated and through which the architect or engineer the building its character. Stairs allow natural light to flow through common areas and landings on different floors. In some cases, they are an opportunity to crown the building with a sculptural feature that emphasizes the importance of this vertical spine.

25

Technical details

- As the number of architects and engineers grows and construction methods become more standard, reinforced concrete becomes the primary material, but we notice an effort to integrate and conceal structural elements within the general architectural writing.

- Dimensions and thicknesses of slabs, columns, and beams, are moreare more tightly controlled in terms of technical performance and coherence to suit the architect's or engineer's design scheme. Structural elements like columns, beams, and slabs, constitute a skeleton that is complemented by a series of architectural elements giving to the building its desired character: The architect or engineer's design tools include blank or punctured walls, exposed columns, window frames or lintels, window shutters, balconies and balustrades, cornices, stairs, parapets, and so on (26, 27).

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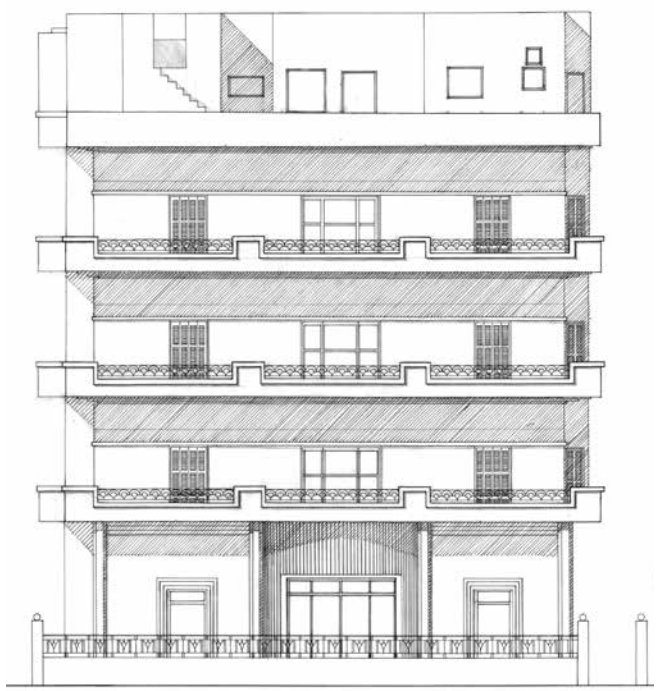

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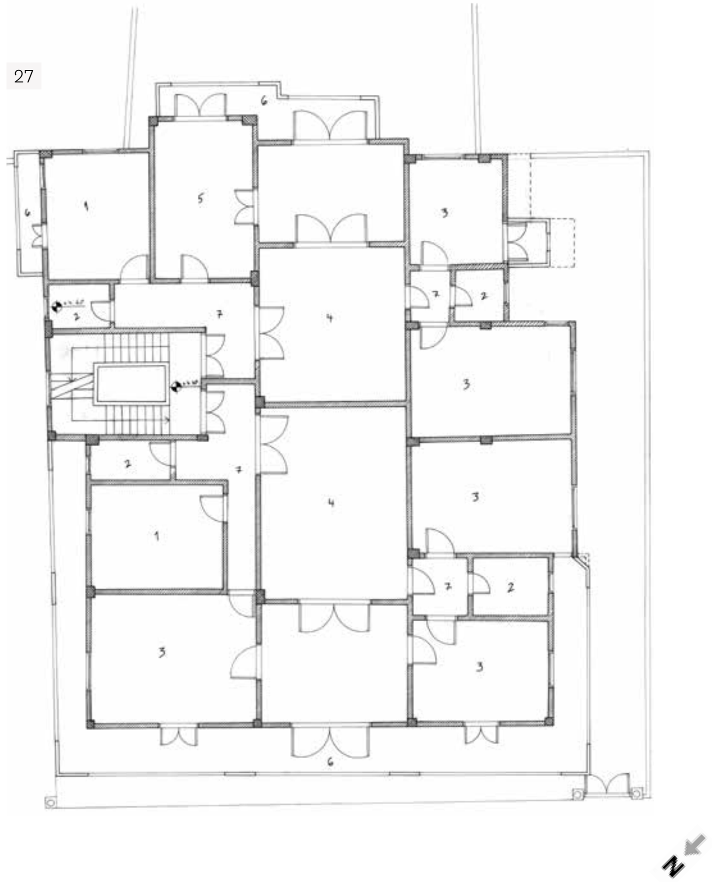

- The concrete structural grid (columns, beams, slabs) can no longer be identified or distinguished from the remaining elements. The reason for this is essentially an effort by the designer to present a balance of void and mass, light and heavy, open and closed, smooth and rough, and so on.

- The work of architects and engineers is paralleled with a wider spectrum of materials and more advanced execution means. During this period, we witness the extensive use of various plastering methods and textures allowing the architects and engineers to explore the builders skills and their ability to implement their ideas (Scratched plaster or *Kratz*, Tyrollean plaster, Float rendered plaster, etc.) (28).

28

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In the second half of the 20th century, Lebanon was marked by the mandate of president Fouad Chehab (1958-1964), founder and former general of the Lebanese army. He introduced important reforms for the establishment of a more secular governance based on the strengthening of the state's institutions. This modernization effort was felt throughout the country in the form of development projects in all sectors of the economy coupled with the improvement and creation of new infrastructure enhancing connections to the main economic hubs (port, airport, industrial zones, etc.) and between cities and villages.

This entrepreneurial state adopted the international style in both its public buildings and urban projects, building on the reciprocity between its political vision for a modern society and the dogmas of the modern movement.

Echoing the Ecochard plan, Beirut had extended towards its suburbs and started to define the outlines of the forthcoming Greater Beirut (*Bayrūt al Qubra*): Khaldeh to the South, Baabda to the East, and Dbayeh to the North.

Land and building regulations evolved accordingly: Expropriation, parcels subdivision and merger, setbacks, parking requirements, etc., are some examples of the mechanisms inspired by modernist urbanism and architecture.

In addition to its growth, Beirut witnesses additional rural migration due to its appealing modernity and the various opportunities it offers. Avenues, boulevards and ring roads are extended to serve the emerging megalopolis.

Architectural Composition

- Architects and Engineers embraced most of the modern movement ideas but with a consistent effort to adapt these novelties to the local context. This was achieved either by using certain architectural elements to respond to local climate constraints or through the integration of materials inherited from earlier periods and the implication of local craftsmanship and know-how in construction, landscaping and furniture fabrication.

- Apart from its delicate insertion in the urban fabric, the building's orientation was also influenced by notions of views and openness to a specific scenery depending on the context. Modern architecture promoted openness and transparency, local architects and engineers somehow perpetuated this idea, already initiated in the vernacular model of the Beiruti house and its triple opening towards the sea (29, 30).

30

- Residential architecture constituted a kind of experimentation field in which architects and engineers explored new techniques of construction, various space configurations, new materials and color palettes.

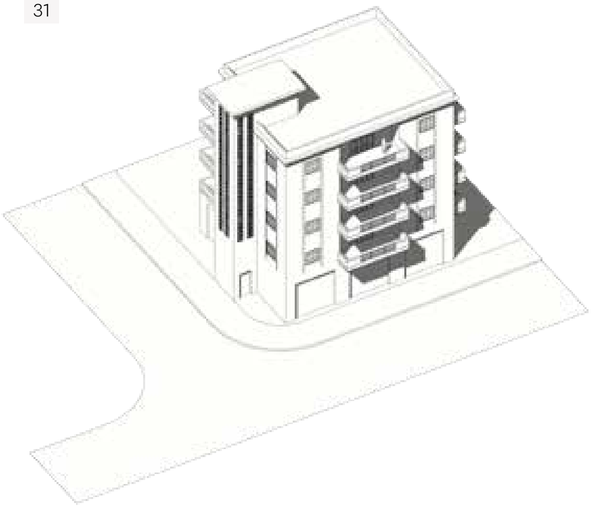
- In this context each part of the residential building was treated along the modernist thought (31, 32):

Building lobbies and entrances were treated like an extension of the public space with landscaping features whenever it was possible to integrate them. Stairs were sculpted and frequently treated as a light and floating element in the section connecting them to the main lobby at ground level. Stairs continued to play the role of a natural light well, while structural engineers relied more on these vertical elements to act as bracing shear walls, which are essential in mid- to high-rise buildings. Apartments were designed around three main spaces: receptions and dining rooms, kitchens and amenities, and bedrooms and family living areas.

- Receptions benefited from large balconies that also served as sun breakers. Balcony edges were often treated with shading elements combined with building structure, creating an interesting interplay between mass and void, light and shadow. The kitchen area, still according to the segregation of functions in the modernist thought, was partially concealed behind claustra elements. These modular blocks allowed for ventilation while hiding the service area behind a screen. Bedrooms were oriented east or south whenever possible to adhere to hygienic principles of proper ventilation and exposure to sunlight.

- On the volumetric aspect, and given the above listed experimentations, we witness the disappearance of the closed volume. Buildings rested often on pilotis, and had their façades treated like floating two dimensional planes assembled spatially rather than physically. Some architects and engineers elaborated further these notions of intersecting planes to an extent where the architectural composition resembled more a mannerist exercise than a rationalist building with a clear hierarchy.

31



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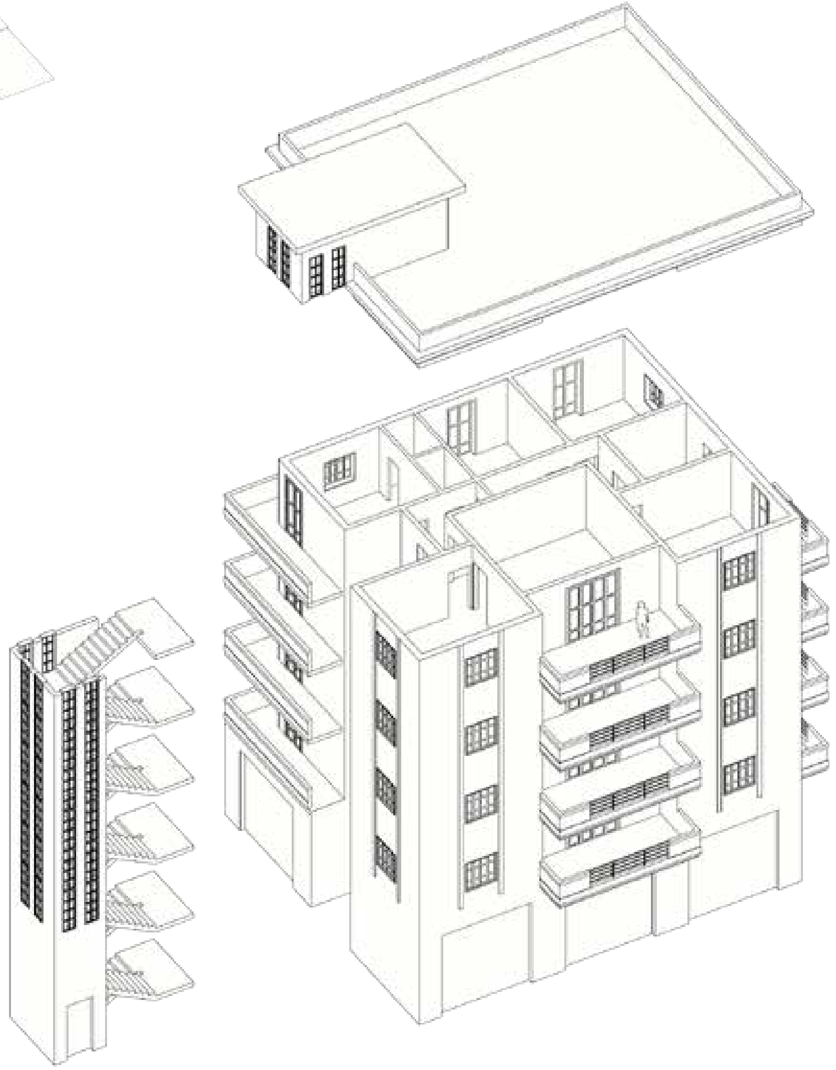

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Technical details

- Architects and engineers collaborated together to provide design services for buildings requiring more technical coordination among the different disciplines.

- Advanced techniques in reinforced concrete allowed more freedom and flexibility. Generous entrance canopies, wider cantilevered balconies and canopies, wider spans and sturdier beams, etc. We notice a will to express the structure of the building and combine it with lighter floating non-structural elements (33, 34).

- Depending on their role in the general scheme, columns, beams, and slabs, are treated in a specific manner to emphasize either the structure itself or to put forward a particular architectural feature. When columns are defining the pilotis floor, they are covered with the material that underlines their form. For example, if the column is rounded, it would be clad with a material adapted to its curvature (smooth plaster, terrazzo cover, mosaic tiles, etc.). Another example is drop beams used on a large span perpendicular to the main facade and extending outwards to carry the balcony slab.

- The effort to create more transparency leads to further fragmentation of the facade into floating elements. Architects and engineers end up combining several materials and developed intricate and sometimes complicated execution details in order to manage the intersection of those various elements. Protrusions, recesses, grooves, connections, gaps, overlaps, etc. are a few examples of such details (35).

- Prefabrication and modular elements become a recurrent practice marking the architecture of that period. Repetition and reproduction can be found at various scales in the building: structural elements (beams, ribs, hollow cores), facade elements, wall panels, claustra blocks, balustrades, etc.

- In the late 1960s, new techniques such as exposed concrete were introduced, sparking further experimentation among architects and engineers. Concrete acquires a new dimension offering the geometry of its mold-shutter and its texture (often wood) as a new tactile experience emphasized by the play of light and shadow.

35

Diagnosis

- Survey and Mapping: preliminary survey based on pacing, sketching plans-sections-elevations, and mapping all categories of defects, failures, or structural disorder, identifying the various materials and their roles (structural, non-structural) and linking them to the building's historical evolution, as well as the technical aspects of the planned rehabilitation.

- Study of the typology: analysis of the building's dimensions and inherent proportions, as well as identification of morphological disruptions or dimensional alterations to understand their causes and incorporate them into the rehabilitation process. The study should take the urban environment into account. The concept of typology is not sacred; it is a tool for analysis and observation, not for directing the rehabilitation process in a literal reproduction of the reference type or model.

- Reconstruction of the historical evolution of the buildings: establish a scenario for the evolution of the building with its various stages of construction, additions, demolitions, and alterations based on the dimensional and visual assessment. To gain a solid understanding of the building's significance, this historical analysis should be conducted in parallel with a thorough reading of the related social and urban transformations.

Rehabilitation strategies

According to Steven Seems, who borrows from James Marston Fitch's classification below, the various types of intervention and preservation treatments listed below can be combined or applied solely depending on several factors that must be evaluated for each building or site:

- Preservation is defined as "the maintenance of the artifact in the same physical condition as when it was received by the curatorial agency. Nothing is added or subtracted from the aesthetic corpus of the artifact."

- Conservation and consolidation are defined as "physical interventions in the actual fabric of the building to ensure its continued structural integrity".

- Restoration entails "returning the artifact to the physical condition in which it would have been at some previous stage of its morphological development."

- Reconstitution entails "piece-by-piece re-assembly, either in situ or on a new site."

- Adaptive use refers to "adapting old buildings to the requirements of new tenants."

- Reconstruction is defined as "the re-creation of vanished buildings on their original sites."

- Replication is defined as "the construction of an exact copy of a still-standing building on site removed from the prototype... (such that) the replica coexists with the original." (Fitch, 1982, pp. 46-47.)

Regardless of the adopted rehabilitation approach used, the guidelines below provide a holistic strategy for intervention that should be tailored and adapted to each case.

- Relevant Structural and Architectural Restoration: Based on the survey and investigation phase, it is critical to maintain the relationship between bearing and non-bearing elements in the restoration works. Of course, any structural disruption necessitates the involvement of a structural engineer, who would plan all necessary reinforcement works (temporary or permanent) in collaboration with the architect. Based on a thorough investigation of the building's materials and the role of each element and layer, the architect restorer makes the appropriate decisions to reinstate the use of certain materials and details or to introduce new ones, depending on the projected usage and material availability and cost.

- Urban and Architectural Integrity: Following a thorough examination of the building's typology and surrounding context, the rehabilitation project should preserve and improve the building's relationship with the urban landscape (open spaces, streets, gardens, courtyards, adjoining structures, etc.). The restoration process should recognize the building's evolving and living character by incorporating elements that contribute to the organic narrative of its architecture.

- Architectural Characteristic Coherence: Building morphology evolved over time as a result of socioeconomic factors in many cases, particularly between 1925 and 1945. A rehabilitation project should aim to preserve the general character of the building, even if it has a heterogeneous appearance due to multiple additions or extensions that have shaped it over time. The subtle relationships that exist between the various parts of a building define its logic. This is visible through the use of a hierarchy of elements on the building's envelope. Base, body and crown; columns, beams, and slabs; walls, doors, and windows; and so on. According to this interpretation, the "whole's" stability and coherence are heavily reliant on the architectural fabric woven between the "parts". Following the identification of the volumetric hierarchy, the rehabilitation project should protect the role of each component (for example, pilotis, base, body, crown, etc.) and restore the separating or connecting elements between those components (ex. slab, canopy, balcony, setback, etc.). It is advised to use the same material or an alternative capable of performing the same function and producing the same appearance (scale, texture, color, etc.).

REINFORCED CONCRETE

Fadlallah Dagher, Rodolphe Mattar, Selim Merhej, Naji Assi

REINFORCED CONCRETE IN THE BEIRUTI ARCHITECTURE BETWEEN 1925 AND 1970

Fadlallah Dagher


36


37

The invention of reinforced concrete in the middle of the 19th century revolutionized architecture and construction thanks to its structural and plastic properties. The use of this modern material spread with the first construction codes which were established in France in 1905. Reinforced concrete was introduced in Lebanon in the early 1920s, following the end of the First World War and the start of the French Mandate.

The use of this new material spread in a decade. In 1927, the *Société des Ciments Libanais* was founded and the local production started. At the same time, the first Lebanese engineers and architects graduated from France, England or the United States were called upon to build new districts in Downtown Beirut, destroyed by the Ottomans during the War: Place de l'Etoile, Foch, Weygand and Allenby streets...

In the 1920s, the use of reinforced concrete was initially limited to the foundations, floors and lintels of doors and windows (38, 39). The architectural type of the central hall plan is maintained. Sandstone (*ramlé* stone) is still used for the construction of the walls, which are still load-bearing. On the other hand, these walls are divided at the level of the lintels of the doors and windows by a reinforced concrete chaining. The floors, made up of solid slabs approximately 15 cm thick, with crossed reinforcements of smooth steel bars, rest on the four peripheral walls. These reinforced concrete floors allowed to crown the building with a roof terrace without the addition of a pyramidal wooden roof covered with tiles.

At the turn of the 1920s and 1930s, reinforced concrete posts were introduced, either embedded in the vertical walls (which thereby lost their load-bearing function and were built of bricks or cement blocks), or supporting the slabs of the verandas. The reinforced concrete load-bearing elements are molded to take the form of elements drawn from the classical repertoire: columns with bases and capitals, consoles, cornices and balustrades... (36, 37)

It was from 1930 that the “International Style” began to spread. The plastic use of reinforced concrete then emancipated itself from the imitation of classical elements, and engineers and architects learned to take advantage of its structural qualities with the use of cantilevered slabs. The Central Hall plan is abandoned in favor of functionalist plans. In fifteen years, the new technique has taken precedence over ancestral methods and vernacular styles.

From the middle of the 20th century, Lebanese engineers and contractors perfectly mastered reinforced concrete construction. The site of the Tripoli International Fair (today Rachid Karamé International Fair) designed by Oscar Niemeyer in the 1960s and implemented by Lebanese consultants and companies, is a perfect example.

Nowadays, Engineering and Architecture schools practically only teach construction methods using reinforced concrete. However, during restoration, the codification of calculation rules can endanger the architectural quality of a building. It is therefore important to understand the stylistic particularities of each building in order to intervene without disfiguring it. The engineer's approach will be sensitive, without giving in to the ease of use of the material or the diktat of contemporary standards and other calculation codes.


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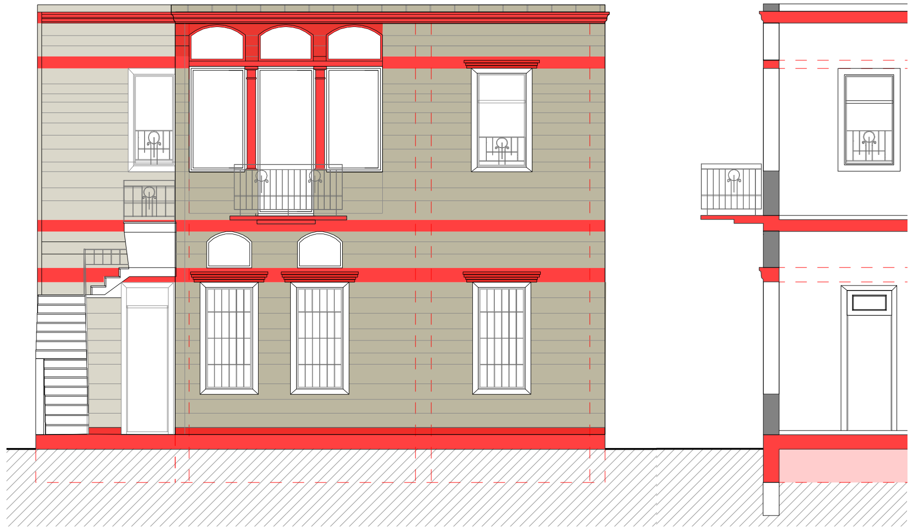
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COMPONENTS OF PORTLAND CEMENT AND REINFORCED CONCRETE

Rodolphe Mattar and Selim Merhej

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1 - Concrete components

Concrete is made up of water, coarse aggregate – pebbles (used between 1925 and 1940) or gravel – and fine aggregates (sand) (40, 42). This base called Cement Portland has several types:

- Type I: Normal – General use;
- Type II: Moderate sulfate resistance;
- Type III: High early strength development;
- Type V: High sulfate resistance.

In addition to these cements there are a number of specialty cements that are used for particular applications or repair mortars.

2 - Concrete Admixtures

Admixtures are ingredients in concrete other than Portland cement, water, and aggregates that are added before or during the mixing to give special properties to the fresh or hardened concrete. In general, there are two categories of admixtures, chemical/manufactured or mineral admixtures also known as pozzolans or supplementary cementitious materials.

<u>Chemicals Admixtures:</u>

- Air entraining agents (AEAs) stabilize air for free/thaw conditions
- Water reducers afford workability with water
- Superplasticizers most effective form of water reducers
- Retarders/Accelerators compensate for ambient conditions
- Corrosion inhibitors protect steel reinforcement (rebar) from corrosion
- Viscosity modifiers allow flowable consistency without separation
- Pigments

<u>Mineral admixtures:</u>

- Pozzolans or supplementary cementitious materials (SCMs)
- React with water and/or cement hydration by products to form more cement paste.
- Typically, these react more slowly than cement, resulting in increased late-age strength, decreased permeability, and increased durability
- These can also impact factors like set time, color, and consistency

3 - Concrete Reinforcements (41, 43, 44)

- Smooth round bars (1925-1945)
- Painted or unpainted twisted bars (from the 1950s).
- Twisted bars painted with epoxy (from the 1970s).

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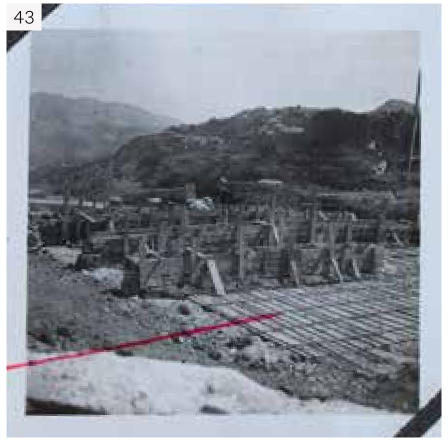

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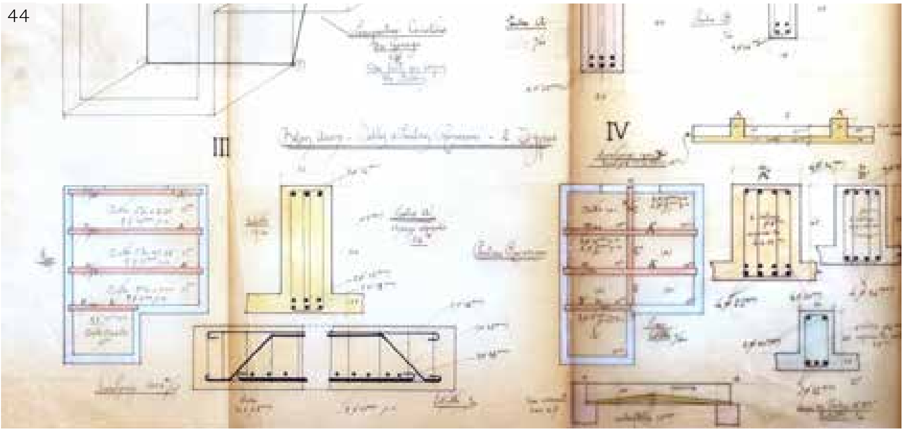

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The extent of pathologies in concrete construction and the corresponding remedies is vast and complex. The objective of this manual is to summarize these concepts to the non-specialized readers, allowing them to approach the cases they are facing in the context of restoration or rehabilitation of their buildings.

Below are the two main reasons causing the degradation of reinforced concrete:

- Cracks in the concrete: reinforced concrete is normally micro-cracked, but this does not affect its durability. However, cracking (starting from 0.3 mm) will put the rebars in contact with the outside atmosphere which could lead to their corrosion and cumulative degradation. A reinforced concrete structure executed according to the norms, and which is not subjected to stresses for which it was not designed, will behave well over time. Before proceeding with the repair of a structure in degraded reinforced concrete, it is necessary to carry out tests to know its resistance, its porosity, and the carbonation depths.

- Corrosion of the rebars: in a humid environment, if the protection of the reinforcements is not sufficient, they corrode and their swelling due to the rust results in the cracking of the concrete cover. These cracks put the reinforcement bars more in contact with the external atmosphere which accelerates their corrosion and the disorders it induces.

Defects in the concrete:

- Damage due to swelling of corroding reinforcements (causes A, B, C, and D).

- Damage due to cracks (causes B and D)

- Erosion of the surface under the influence of weather elements (rain, wind, sand).

- External decomposition initiated by acids secreted by mosses that grew in the crack's cavities.

- Surface cracking or chipping due to frost for concrete with insufficient mechanical resistance (cause A).

- Cracking induced by reactions internal to the material, example swelling alkali-silica reaction, very high expansion ettringite (cause A).

Defects in the reinforcement bars

- Corrosion following a lack of protection (carbonation of the concrete) of the reinforcements and / or contact with air humidity. This corrosion leads to reductions in section and can go as far as breaking the reinforcements.

- Pitting corrosion: due to the presence of chloride (causes A and D) even in non-carbonated concrete. May cause brittle fracture of reinforcement.

Main causes of pathology

A. Inadequate composition of the concrete

- Excess water making the concrete porous (insufficient protection of the reinforcement bars).

- Presence of alkalis contained in the concrete and silicic acid contained in the aggregates which can react together (swelling reaction).

- Contamination by chlorides incorporated voluntarily during execution to accelerate the setting of the concrete or naturally present in the components of the concrete.

B. Design issues

- Insufficient rebars sections leading to cracks.

- Insufficient concrete cover to protect the rebars.

C. Defects during execution

- Bad mixing of the concrete and the infiltration of air bubbles leading to honeycombing effect, itself weakening the concrete cover.

D. Problems during the life of the structure

- Cracking due to thermal expansion or impeded shrinkage of concrete, due to impact or explosion.

- Contact with acids, de-icing salts.

DETERIORATION AND DISTRESS IN REINFORCED CONCRETE STRUCTURES

Rodolphe Mattar and Selim Merhej

The deterioration of concrete can occur during the pre-construction, construction or post-construction phase. Some flaws in design or materials also lead to degradation of concrete.

There are numerous causes of deterioration, including freezing and thawing, erosion, material corrosion, carbonization, and chemical attack. Overloading, fire, earthquake, vehicle impact, blast, or explosion are all causes of concrete destruction.

1- Defects in the pre-construction stage

Caused by miscalculation of design loads and/or thermal movement.

2- Defects in the construction stage

Due to swelling of the formwork or premature removal of the formwork, vibrations due to inadvertent walking on fresh concrete or accidental spillage of construction materials, or a high water/cement ratio.

3- Defects in the post-construction stage

- Cause: meteorological and environmental conditions, due to unfavorable conditions such as rapid heating then cooling, wetting then drying, or erosion (45).

- Prevention: Ensure sufficient reinforcement allowing excellent tensile strength, use high-strength concrete, and a good protection system (finishing, waterproofing, etc.)

45

Distress in Structures

Structural distress

- Caused by faulty design , faulty construction and/or overloading
- Endangers building safety
- Needs immediate action

Non-structural distress

- Caused by internally induced stresses in components
- Looks unsightly
- Indirectly leads to structural weakening

Factors causing distress

External

- Overloads due to dead load, live load, wind load, seismic loads, accidental loads etc. which are not accounted in the design.
- Differential settlements in the foundation
- Fire Damage

Internal

Dimensional changes induced by:

- Moisture penetration
- Temperature changes
- Horizontal deformation of building components
- Volume changes due to chemical action
- Weakness in tensile and shear stresses

TYPES OF DISTRESS IN REINFORCED CONCRETE STRUCTURES

Concrete Spallling

Spalling is a term used to describe areas of concrete which have cracked and delaminated from the substrate. There are a number of reasons why spalling occurs including freeze thaw cycling, the expansive effects of Alkali Silica Reaction or exposure to fire. However, the most common cause of spalling is the corrosion of embedded steel reinforcement bars or steel sections.

46

Concrete Scaling

Scaling is local flaking or peeling of a finished surface of hardened concrete as a result of exposure to freezing and thawing. Generally, it starts as localized small patches which later may merge and extend to expose large areas. It is recommended to use air entrained in the concrete mix to prevent the scaling effect.

47

Concrete Abrasion

The concrete abrasion is the superficial de-bonding phenomenon of the concrete constituent.

48

Freeze-Thaw Effect

Freeze-thaw weathering is an erosion process that occurs in cold areas where ice forms. When the temperature rises again, the ice melts and water fills the crack's newer sections. As the temperature drops, the water freezes again, and the ice expands, causing the crack to expand even more.

49

Chemical attack

Due to chemicals that attack the cement paste (organic or inorganic acids, acid solutions, sulfate, waste water, etc.).

50

Concrete disintegration

Deterioration or decomposition of concrete into small fragments, most commonly caused by freeze-thaw, sulfate or charring.

51

Concrete delamination

Separation of the paste layer on the surface, which creates a layer of concrete not bonded to the body of the slab. This problem develops with screeded concrete, usually in early spring and late fall with the placement of fresh concrete on a subgrade. The risk of concrete peeling increases when conditions for rapid surface drying, such as low humidity, sun and wind, are present. In effect, the surface looks ready for smoothing when in fact the concrete underneath is still like plastic.

52

Cracking in concrete occurs when the tensile strength of concrete is exceeded. This is not necessarily indicative of poor quality concrete.

Structural cracking

Affects the integrity of the structure. It is important to assess these cracks. If they are stable, epoxy injection can restore the structural capacity. If the cracks increase, reinforcement may be necessary.

53

Drying shrinkage cracking

Typically, it is not a structural issue. As concrete dries, it loses volume and shrinks, which can cause cracking.

Plastic shrinkage cracking

Called "map cracking" or "Spiderweb cracking", these cracks appear in a semi-hardened condition (plastic state). These cracks form when the water on the surface of the concrete evaporates before the bleed water has risen to the surface. This can be aggravated by a combination of high wind speed, low relative humidity and ambient temperatures. Although these conditions are more common in the summer months, they can occur at any time. The use of evaporation reducers, temporary wet coatings or fog spray may be beneficial to reduce the risk of plastic shrinkage cracking. Using temporary windbreaks and sunshades when placing the concrete can also help. Cracks tend to be shallow and usually form around aggregates.

54

Thermal cracking

Occurs when the temperature of the concrete is higher than the ambient temperature. The use of joints, such as expansion joints, is a means of indicating to the concrete the place of production of its cracking.

Early thermal cracking

Caused by a section of concrete that exceeds its tensile capacity. This results from restrictive thermal contraction or temperature rise. The main cause of early thermal cracking is the release of heat of hydration from the binder, usually cement paste in the concrete.

Corrosion

The corrosion of reinforcing steel and embedded metals is likely the single largest reason that concrete needs repair. Expanding rust causes cracks. Over time, corrosion products build up and cause larger cracks until the concrete pulls away from the bar. Corrosion is due to external sources, deicing salts or coastal locations (salt spray).

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Fire induced structural damage

Peeling of surfaces due to extreme heat (fire). Moisture quickly turns to steam, causing localized spalling of small pieces of concrete. As the temperature increases, concrete experiences cracking, spalling and a decrease in stiffness and strength.

56

In this session we are focusing on surface repairs with some general guidelines for some structural strengthening works (59, 60).

The first phase for the repair is to conduct a damage assessment, followed by an analysis for the repair strategy which would reinforce the structure, without altering the aesthetics of the building.

1- Repair materials:

Repair materials should have high performance and durability, with low maintenance. They must also be easy to use while having high productivity and a reduced construction cycle.

Repair materials should be safe for workers and users, environmentally friendly (do not emit toxic fumes), and should not add to the dead weight of the structure.

2- Types of materials:

- Portland cement-based materials (57, 58)
- Concrete modified with polymers
- Resin-based mixtures
- Substitute materials / Recent products

The objective is to ensure that the repair material is as close as possible to the properties of the host concrete.

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1- Surface preparation

Repair geometry is an important factor in a successful repair. Concrete does not like irregular shapes or to go around corners. The best shapes are square or rectangular with an aspect ratio of 1 to 1.5. If longer repairs are necessary, control joints are important to reduce the potential for cracking. If the repair mortar must go around a corner, consider adding a joint.

Once the perimeter is determined, the area should be isolated with a saw to create a straight edge. The perimeter should always be trimmed to avoid “feather edges” of the repair materials (61).

The steps are as follows:

1- Remove all unsound concrete

2- Roughen base concrete

3- Dampen with water

4- Remove all standing water

5- Apply a bond scrub coat

6- Do not allow bond coat to dry or re-temper

7- Undercut exposed corroded rebar

8- Minimum 3/4" behind rebar – so that gloved hand easily fits behind

9- Secure loose reinforcement

10- Replace or add rebar as required

11- Sand blast

12- Rebar free of bond inhibiting corrosion

13- Water blast

14- Wire brush

15- Commercial blast

16- Remove damaged concrete

17- Inspect for damage

18- Apply a protective coating

2- Application methods:

- Vertical and overhead: Ideal for small repairs or surface defects. It is a method applied by hand, quick and easy to install. The friction layer at the bond line is essential for the material to grip properly.

- Form and Pour / Form and Pump: Involves placing the formwork and pouring the repair material into the prepared void. This solution is used for medium to large repairs, but it involves additional time and labor for the repair of the formwork.

- Concrete Topping: Ideal for repairing top side surfaces. Involves the placement of repair material at a fluid consistency on a horizontal substrate, struck flush. This method is easy to install, and repairs in depth.

- Spray applied: Ideal for large repair areas. Low-velocity spraying can be done with a dry-mix (Gunite) or wet-mix (Shotcrete). The process should not be interrupted during the wet mix process.

- Crack Injection: Injection is a procedure of pumping cement based, polyurethane based, epoxy based or acrylate-based material into damaged or cracked structures to securely seal leaks, repair compromised structures and make them watertight again for the long term.

- Jacketing: Reinforcement in compression by widening, or containment. Enlarging the cross section of an existing column will strengthen the column and increase its load capacity. However, the effects of drying shrinkage in the concrete used to enlarge the column must be considered. The drying shrinkage will induce tensile stresses in the new part of the column.

- Bending reinforcement: The bending capacity of concrete members requires an increase when a design flaw is detected, excessive deflection occurs or additional loads are anticipated. Various techniques are used to increase the bending capacity including concrete cover, external post-tensioning, externally bonded rebars, concrete coatings, shortening span length, and supplemental support.

- Underpinning and foundations repair: Underpinning is a methodology using several techniques or just one whereby it is possible to arrest, repair and or reinstate foundations. Please remember there is not a single method of underpinning which will be suitable in every circumstance and to be effective, careful considerations of things such as ground conditions, soil types, structural loads and other tangibles such as site restraints including access and ultimately costs, will help to determine the most appropriate method of underpinning to use.

- Drying method: A critical phase that requires critical watering for a reduced surface shrinkage effect, increased durability, and maintaining volume stability.

3- Structural Health – Continuous Monitoring:

Periodic visual inspections and localized non-destructive testing do not necessarily help detect sudden structural changes. The analysis and evaluation of the structural integrity must be followed by an expert. For an evaluation that would not cause destruction, the part of the structure inspected can be rendered inoperable for the duration of the tests.

61


CONCRETE ELEMENTS

Fadlallah Dagher, Mazen Haïdar, Yasmine Dagher

Columns and railings, door and window frames, acroters and decorative panels

Beginning in 1925, reinforced concrete began to spread and replace wooden structures in the construction of floors. The use of concrete was not limited to structural elements; it also included the decorative elements of the façade. Architects and builders alike took advantage of the plastic properties of reinforced concrete by pouring it into molds carved from form-work wood. Most parts are prefabricated and have steels at their ends waiting to be integrated into the construction.

In its early days, reinforced concrete reproduced the shapes of classical elements, previously cut in stone or marble, hence the finesse of the proportions of columns, consoles, balcony slabs, cornices, etc. On the other hand, this made the weakly reinforced concrete fragile, as it did not have sufficient coating to protect the steels. In his book "Beirut Architectures at the Sources of Modernity, 1920-1940", published in 2009 by Editions Parenthèses, Robert Saliba describes these elements and illustrates their vocabulary.

1. The columns: They usually adorn the porches and wide verandas (rectangular or semi-circular) of houses and buildings of the interwar period. The circular or square section shafts, 25 to 30 cm wide, rise above a square section pedestal at railing height (62, 63). They are either smooth or fluted and end with a capital that carries a fall beam that serves as an entablature (64). Initially, these columns were primarily Moorish (*mukarnas*) or semi-classical (simplified Corinthian, Ionic, etc.) in style. From 1930, however, their shape was adapted to the Art-Deco style; the profiles were simplified and characterized by their geometric shapes. The concrete was usually covered with a light whitewash (yellow, white, or pink) but was sometimes left raw, smooth, and with exposed gravel (65, 66, 67).

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2. The railings: Between 1925 and 1940, molded reinforced concrete grilles adorned the verandas instead of wrought iron railings (see page 188). These grids are cast in repetitive modules of 60 to 100 cm in length, reproducing figurative patterns (interlacing, lyres ...), classic (balusters) or geometric (68, 69). They are armed with 6 mm steel rods coated with concrete of a 5 cm cross-section. The modules are recessed between the pedestals of the columns. They are horizontally linked by a plinth in the lower part and a handrail in the upper part. Both are made of reinforced concrete poured in one piece and sealed to the pedestals of the columns (70, 71, 72). The railings are covered with a light whitewash. (see page 92)

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3. **Door and window frames:** These façade ornaments are slightly protruding and more or less elaborate depending on the style of the building. With a semi-classical entablature or a simplified or baroque pediment, the lintel is the most decorated part. The date of construction or the initials of the owner are often molded or engraved above the entrance gate (73, 74). The frames and lintels of the doors and windows are linked to a horizontal chaining of reinforced concrete that supports the masonry walls (sandstone, bricks, or prefabricated solid blocks of cement). Located two-thirds of the height up the wall, these chains have contributed a lot to the lateral resistance of the walls from earthquakes and the brunt of the August 4, 2020 explosion (75, 76, 77, 78).


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4. The consoles: The protruding balconies of the facade are placed on reinforced concrete brackets with either a simple inverted staircase design or an elaborate imitation of classic or Art-Deco profiles (79, 80, 81, 82, 83).


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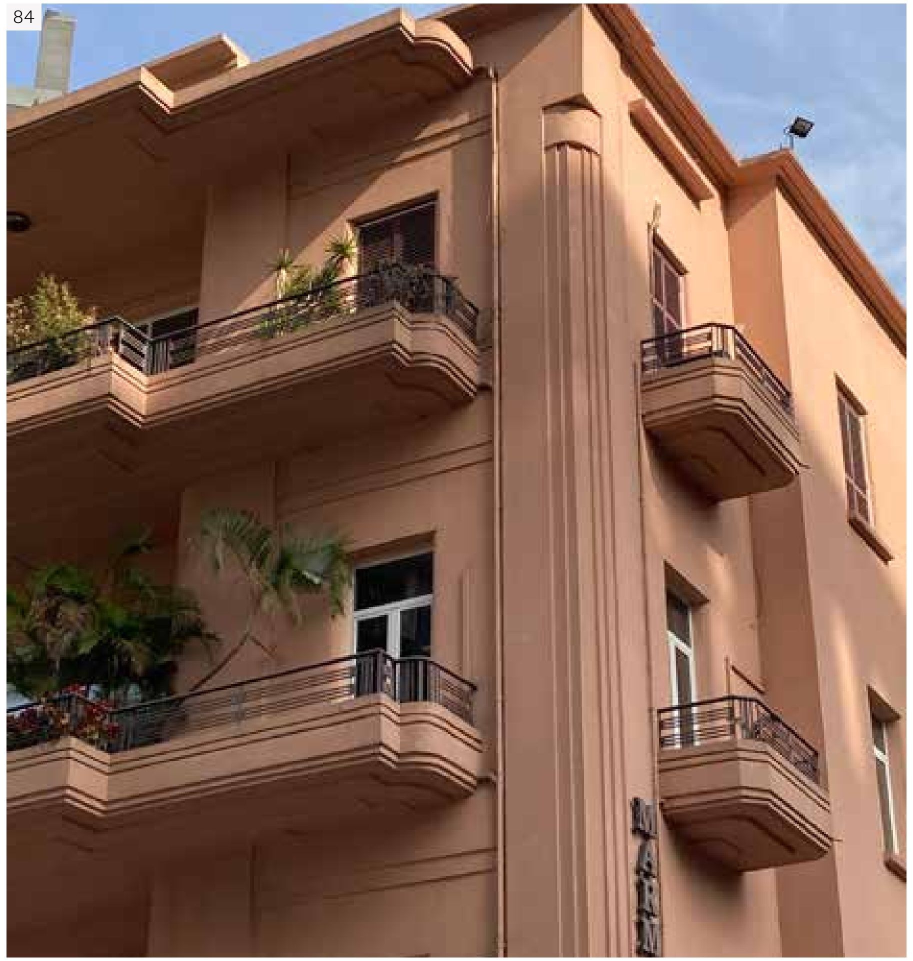
5. **Cantilevered awnings and balconies:** first introduced around 1930, when the first generations of engineers began to master the capabilities of reinforced concrete. A stepped soffit is created by these protruding elements (84, 85). Based on the optimal structural calculation of the bending moment, the section of the protruding reinforced concrete floor is refined as it advances.

These Bauhaus-inspired elements frequently have rounded shapes. The balconies are finished with parapets made of hollow and plastered bricks or wrought iron railings (86, 87, 88).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6. The crowning: parapets and cornices: These elements are located at the top of the building, above the parapet or crowning cornices of the roof, and they stand out against the sky (89, 90). They cap the vertical lines drawn by the columns or the corner pilasters and emphasize the vertical dominance of the composition (91). The vocabulary of acroteria includes vases, palmette or stepped motifs (92, 93).

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7. The decorative panels: These molded elements adorn the intermediate spaces located between the lines that structure the façade (pilasters, frames, and slab noses). They are embedded in the masonry during construction. They are rectangular or square (94, 95) in shape. The motifs are composed of vegetal forms (bouquets, sheaves…) or geometric Art-Deco designs (radiating lines, interlacing…) (96, 97, 98). They are sometimes developed and extended to the point where molded geometric labyrinthic patterns completely cover the facades. This ornamental model creates subtle shadow lines that animate the façade

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8. The bay window or protruding kiosks: between 1925 and 1935, buildings frequently featured protruding pieces projecting from the street façade: staircase landings or projections from the central hall were expressed as corbelled pieces placed on consoles in molded reinforced concrete (99, 100). Their facade has ornaments molded into the surface of the concrete; it is divided into two or three bays by square section columns, with a molded panel in the lower part, wood-framed windows in the center, and an upper decorated transom (101). These architectural elements are similar to advanced oriental kiosks, and they often have thin side openings facing each other to benefit from cross ventilation and visual perspectives on the street (102).

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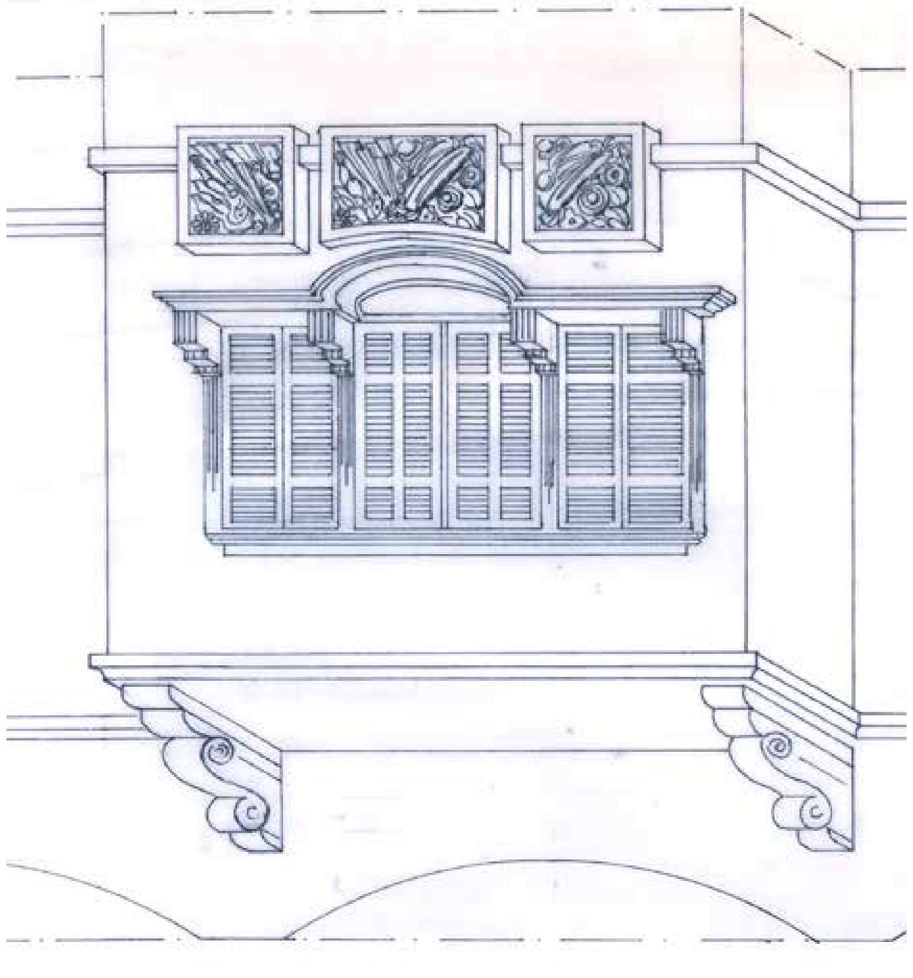

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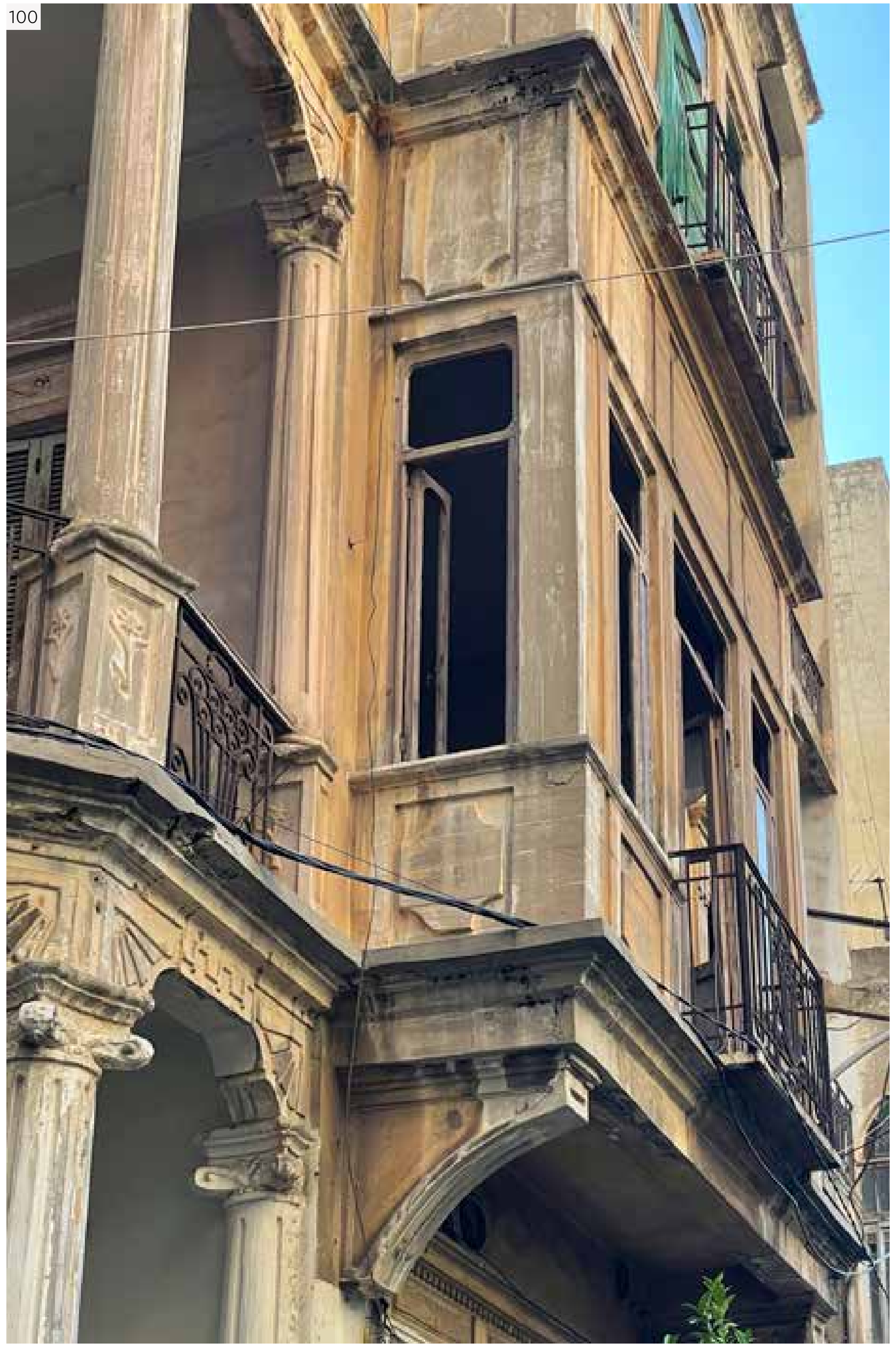

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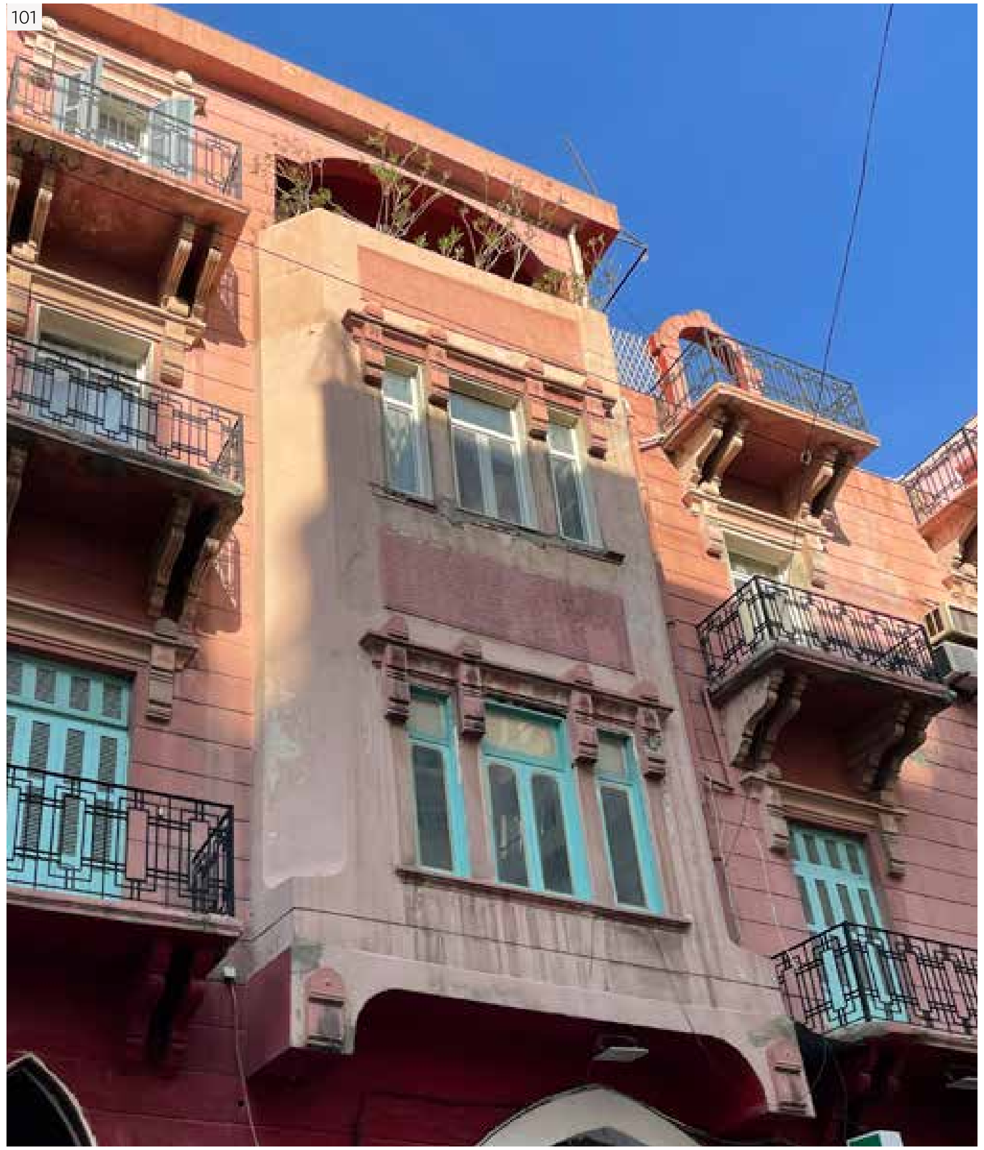

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Pathologies

Throughout their history, molded elements have suffered from two main pathologies:

1. Corrosion of steel reinforcements: This is the most common and serious. Indeed, concrete is not a waterproof material, especially when it was poured in an artisanal way and without a sealing aid (unavailable at the time). As a result, reinforcing steels are subjected to corrosion, which results in swelling and wear of their section and causes cracking of the concrete coating. This pathology particularly affects the protruding moldings (nose of slabs, consoles) and the elements of railings whose coating is the least thick (103, 104).

2. Shock breakage: The impacts of shrapnel and bullets from the Civil War affected the surface and protruding parts of the moldings. The blast of the explosions of August 4, 2020 has displaced and broken elements weakened by the wear and tear of time.

Treatment

The type of treatment adopted will depend on the extent of the damage observed. Minor damage may be repaired with a coating or a finishing cement without shrink (non-shrink grout) after inspection and brushing of the reinforcements, eradication of rust, and protection of steels (see pages 58-61).

Partially or completely destroyed elements will be reproduced for replacement. An accurate inventory will be conducted. If some have disappeared, we will refer to the similar elements existing on the façade. On the basis of inventory and observations, a wooden or resin formwork will be made (depending on the quantity of parts required and the degree of fineness of the detail). The modular balustrade or decorative elements can be poured in fine-grained, high-strength cement, with fiberglass reinforcements to allow them to better withstand the wear of time. For elements with a structural function (columns, lintels, and slab noses), the advice or consult of a structural engineer may be needed.

Finally, restored elements will be covered with a whitewash of identical color to that of the façade.

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The first use of cement in residential buildings railings dates back to the 1920s, when this material was introduced in Lebanon. Beirut's development of self-supporting verandas introduced a fairly diverse formal register into the construction of these works. Railings with square or pear-shaped balusters are among the most basic (106). In other cases, the handrail may be supported by larger elements of various shapes, such as the archaic zither seen in many buildings. The material's flexibility allows for ornamental exploration that can go beyond traditional forms by using local motifs such as the cedar of Lebanon or complex systems that group together different representations within the same structure (105, 107, 108). In the mid-1930s, the last railings installed had a geometric composition inspired by the Art-Deco movement, similar to the wrought iron production (109).

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These structures, which are molded in metal or wood formwork, have a smooth steel reinforcement in the form of round bars. The precision and skill of the master craftsman are generally reflected in the quality of the intricate pattern execution. Some railings are made with special care in the raised parts, where any trace of the formwork is minimized, if not invisible. Concrete railings can also be distinguished qualitatively by the grain size of the mortar used. The finer it is, the better its adhesion to the reinforcement. Because it does not contain large gravel, this type of recipe ensures a more precise definition of the most elaborate decorative elements.

The concrete railings of the French Mandate period exhibit a variety of pathologies, which are often exacerbated by a lack of maintenance. Let us start with the problems caused by carbonation of the cement that reaches the reinforcement of the molded concrete. Numerous examples show that oxidation and corrosion of the reinforcement cause spalling of the concrete. External attack of the reinforcement by chloride ions, such as sea salts present in the air, can also cause cracking and local detachment of the material. This phenomenon is frequently accelerated by the presence of different sized breaks in the work caused by an inadequately compacted mixture, improper use, or the effects of war. Another issue that frequently arises in reinforced concrete railings is the use of summary interventions. The accumulation of repair mortar and paint layers generally transforms the surfaces of the various elements and significantly alters the figurative whole.

The reinforced concrete railing intervention includes the consolidation of existing elements as well as the reconstruction of missing or completely degraded parts. After the surrounding concrete has been purged, the reinforcement must be anti-rust treated before it can be repaired. Molds can be made on the sound parts if the concrete module or the handrail are missing or unrecoverable. Patching operations performed on a regular basis in the past frequently resulted in a formal discontinuity with the original structure as well as problems with repair mortar adhesion. When eliminating these interventions does not weaken the original structure, it is permissible.

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PILOTIS AND CANOPEES

Yasmine Dagher

The Pilotis

The pilotis floor (*Tabiq a'mida*) consists of a landscaped area, the building's entrance hall, a few parking spaces, and a series of exposed columns supporting the building at ground level. Between 1955 and 1970, the pilotis find their most successful architectural expression in modernist buildings (112, 113).

Pilotis are one of the five points of modern architecture published by Le Corbusier and Pierre Jeanneret in 1927 [1]

The ground floor became a private, closed, and rather dark space after the entrance halls were integrated in the 1940s. The pilotis integration allowed for the opening of this space to the street, resulting in a semi-private, open, naturally lit, and green space. The Pilotis floor also lends a sense of lightness and floating to the structure, which is supported by reinforced concrete pillars.

[1] *"Les cinqs points d'une architecture nouvelle", Le Corbusier and Pierre Jeanneret, 1927.*

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These reinforced concrete elements, which are circular in shape, are covered with a smooth or rough coating, terrazzo, or molten glass mosaic tiles (114, 115). The pilotis are part of the building's supporting structure and are transformed into rectangular-section pillars on the upper floors.

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The Canopies

The canopies (*Rifraf*), or awnings, are elements that are cantilevered or supported by columns and form a shelter on the ground floor before the entrance door (116, 117). These structures, like the Pilotis, define the intermediate space between the public (sidewalks and streets) and the private (entrance hall).

Canopies can provide natural light through openings or artificial light through the use of light fixtures built into the structure.

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Because of the malleability of reinforced concrete, the canopies take on a rectangular or curved shape, emphasizing the identity of the building and its entrance. These elements are protected by a coating similar to that used on the facade (smooth or textured).

The pillars that support the canopies can be thin in section, allowing the canopy to have a floating effect (118, 119), or thick in concrete, integrating into the entrance (120). These pillars are not part of the building's supporting structure, and their purpose is to support the canopy that welcomes residents and visitors. The canopy slab frequently slips beneath the first-floor slab.

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Pathologies

The pilotis and canopies are mostly broken due to impact: Shrapnel and bullets from the civil war impacted their coated surface. The explosions on August 4, 2020 moved and broke elements that had become weakened over time.

Treatment

The type of treatment will be determined by the extent of the damage. Minor damages will be filled with the appropriate filler or coating. Concrete elements that have been partially or completely destroyed will be replicated and replaced. If these elements, particularly the pilotis and their slabs, have a structural function, we will seek the advice and opinion of a structural engineer. After the elements have been restored, they will be covered in their original materials, reflecting the façade's identity.


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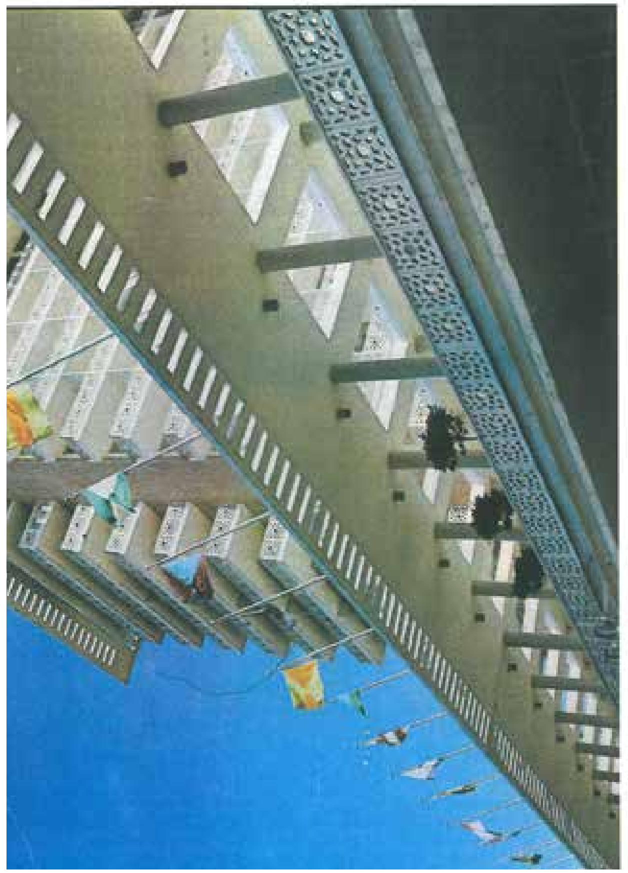

The spread of the principles of modern architecture and functionalism imposed a simplified model of the façade by the end of the 1930s. The smooth façades open more widely, and let the sun penetrate interior rooms. The balconies and large windows of the south, east, and west façades are adorned with protruding sunshades made of coated reinforced concrete, forming either a horizontal or vertical grid depending on their orientation (126, 127, 128, 129). The use of sunshades will be systematized in the 1950s and 1960s to protect the facades of the Mediterranean sun. Architects then use the solar diagram to anticipate the penetration of rays and determine the depth or protrusion of the elements. These sunshades sometimes completely mask the exposed façade (such as in the headquarters of *Dār al Sayyad* and the EDL) (137). They also sometimes take the form of a claustra placed in the upper part of the openings of main balconies.

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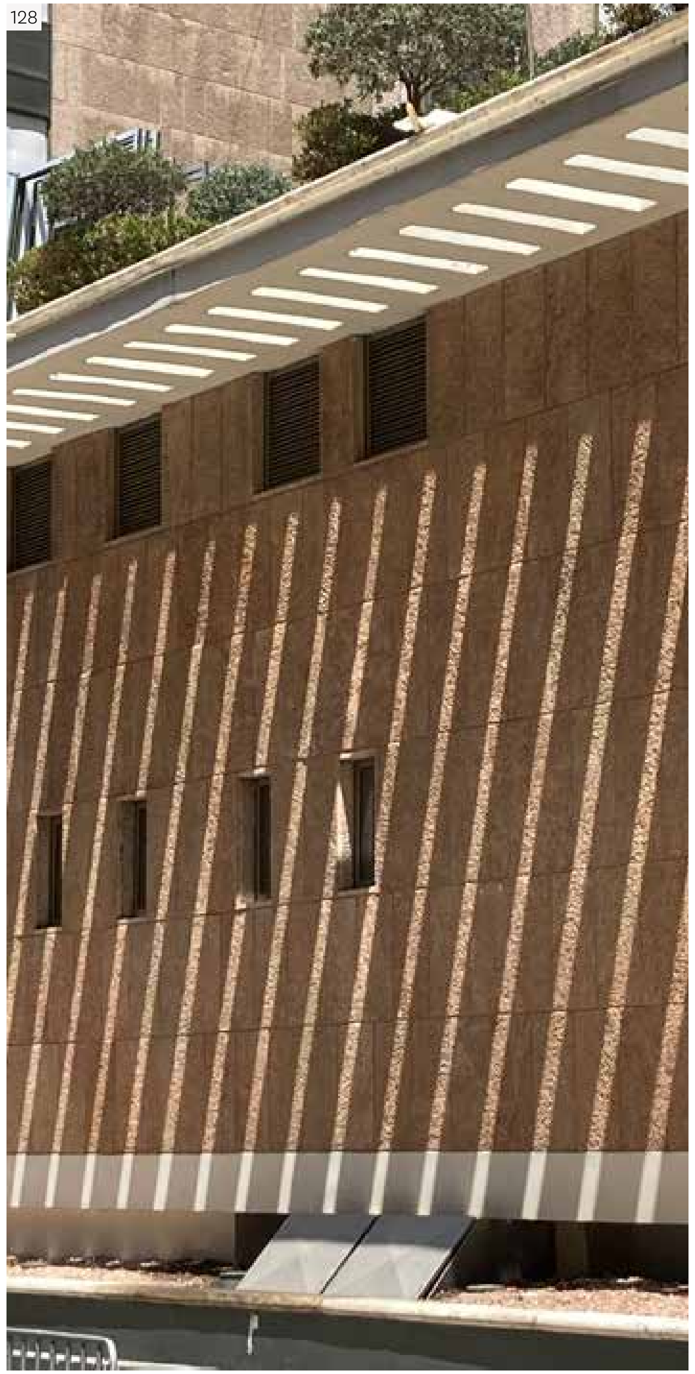

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Claustras are mainly used to completely hide the façade of service spaces. Their use became widespread in the 1950s and 1960s. They consist of an assembly of modular prefabricated parts adopting simple or elaborate geometric designs, 20 cm across, in cement (gray or white) and without reinforcements. Some architects will use claustras to articulate and animate the façades (Schayer), and sometimes, contrary to functionalist logic (J.P. Karam), for purely aesthetic composition (130, 133).

From the 1960s, the material of claustras and sunshades diversified with the introduction of fiber cement (*eternit,* asbestos-cement sheets) and aluminum (132, 134).

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Pathologies and treatment

From cracking to corrosion, reinforced concrete sunshades suffer the standard pathologies that affect this material, and will be treated accordingly. As for the sunshades and claustras made only of cement or aluminum, they have withstood the wear and tear of time very well and are only affected by shocks and impacts resulting from acts of violence that have occurred especially since 1975 (135, 136).

The repair of claustras will be based on the replacement of broken parts with identical parts. If they are not available on the market, it is easy to have them manufactured, in cement or aluminum.

Important Note

Fiber cement elements (façade or roof panels, false ceilings, pipes, etc.) pose health hazards because of the asbestos particles they emit. In the event of restoration or as an obvious precautionary measure, there is a provisional method of encapsulating the asbestos-cement elements. But to permanently decontaminate the building, it is recommended to have these elements removed adequately. We will consult specialized literature as well as standards, specifications, and methods available on the Internet, among other places (INRS website, others…).

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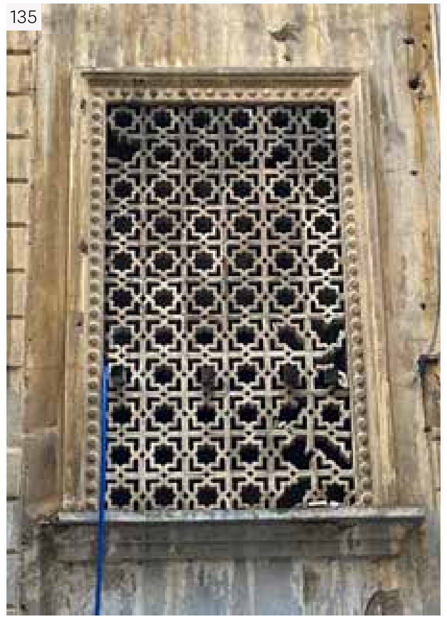

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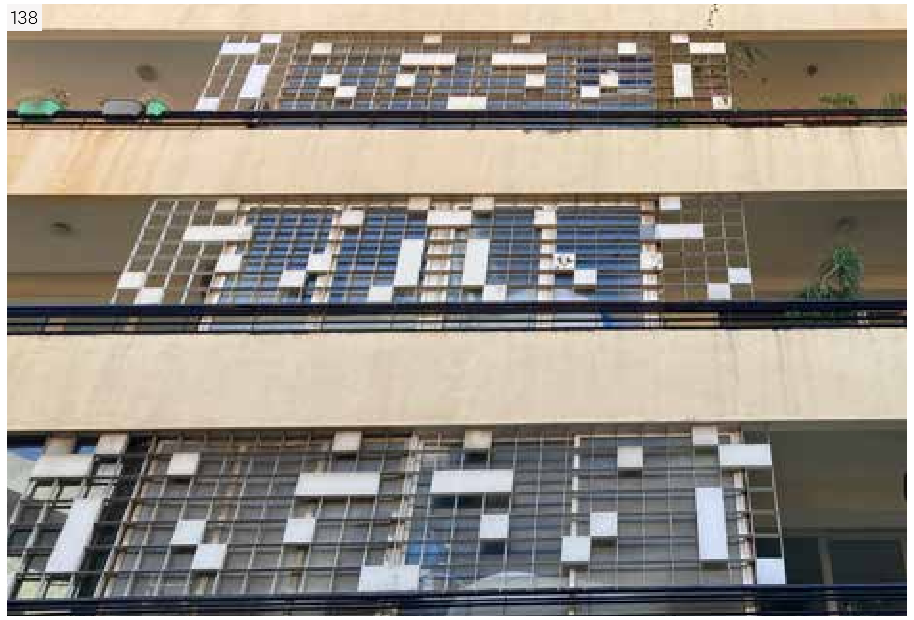

COATING AND FINISHES

Fadlallah Dagher

Since 1925, architecture in Lebanon, as elsewhere in the world, has been revolutionized by the introduction of Portland cement and its offshoot, reinforced concrete. The previous chapters presented the structural and spatial possibilities offered by reinforced concrete. The following sections will focus on the treatment of surfaces, the elements and their materiality, as well as the tectonic parameters of modernist architecture.

Modernist architecture is largely defined by the predominant use of a single material, Portland cement, in its construction. Characterized by its malleability and versatility, Portland cement is used in everything from load-bearing structures to the masonry of walls, interior and exterior plasters, floor tiles, stair steps, sunshades, and partitions. The almost-exclusive use of this material lies at the heart of the materiality of modernist architecture, where the rare finishes of facades play secondary roles . It is also thanks to the sturdiness of Portland cement that most buildings survived the turn of the century without major alteration. This durability is also behind the largely unified character of urbanism before 1970— which remained harmonious despite the ever-growing number of engineers and architects, and the diversity of their personal and/or international influences. It should be noted that cement-based finishes allow for durable textured and colored materials, imitating, at a much lower cost, stone or marble (*terrazzo*).

Cement-based coatings

Cement plaster on the masonry serves as a means of smoothing its surface, protecting it from the weather, and improving its aesthetic. The plaster is applied to reinforced concrete structures and cement masonry walls. It is composed of fine sand, a binder (cement), and water. The mortar is then applied in three coats: the priming or speckling (*rashet mesmar*), the coating body (*waraqa*), and the finish or topcoat. This manual will not expound the composition and the application methods of these coatings as they are widespread and readily available in extant literature on the topic.

Note: Cement coatings are only suitable for cement-based inert substrates such as reinforced concrete or cinder blocks. For walls built of stone or brick, a lime-based plaster is preferred. A cement coating on stone or brick traps moisture within the material and causes efflorescence on the surface (*temlih*). .

Before coating a wall, it is recommended to lay slats that serve as landmarks (wada'at) to help obtain a uniform surface for the required architectural design. The wall must be moistened before each application of plaster.

The priming - This layer allows the plaster to adhere to the wall. It is composed of one volume of cement for one-to-two volumes of coarse-grained sand (0 to 5 mm). The sand will have to be washed. Water is added until a very liquid mortar is obtained. The mortar is then applied to the previously moistened wall. This layer does not need to be even and can vary between 4 to 7 mm in thickness.

The coating body - The coating body has an average thickness of 15-20 mm. To apply it, the coater wields a trowel and a float (*melij*) and spreads the mortar in broad circular arcs. The layer is then flattened according to the pre-installed landmarks (*wada'at*) with a wooden or aluminum ruler (*eddé*), 2 or 3 meters in length. .

The topcoat or smooth finish - After giving the mortar time to dry slightly, the coater smooths out the mortar by lightly moving the wooden float in circular movements. This is done gently and without pressing down the float to avoid the suction cup effect and to obtain a smooth, flat finish. Before the coating dries out completely, the surface is smoothed with a sponge float, then subjected to a finishing whitewash. Whitewashes from the 1930s to 1960s were made with a mixture of water, lime, and dye (yellow or red ochre, ultramarine blue [*nile*], etc.) and directly applied on the smooth coat using a brush and without a primer layer (*ma'ajouné*).

Note: It is recommended to avoid applying plaster layers 30 mm or more in thickness. Thick layers may crack or even peel off under their own weight. However, if the conditions of the site require it, it is possible to add a 10-12 mm topcoat on a previously scratched coating, allowing it to adhere more durably.

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Tinted and textured coatings

Standard cement plaster has a gray color. However, a more expensive alternative, white cement, is sometimes used for tinted topcoats. This finishing plaster is applied to facades and to some interior walls and textured according to the required design or function of the wall.

To obtain a tinted coating, white cement is mixed with stone powder (with or without sand). The proportions depend on the desired shade. The majority of tinted coatings used in Beiruti architecture is either yellowish/ochre colored (for which *Mansourieh* stone powder is used), or white/cream colored (for which white limestone or white marble powder is used) (141, 142, 143). The tinted coat is applied to both primary layers (the primer and coating body). The benefit of tinted coating lies in its durability; well-tinted, the plaster does not fade over time.

Tinted finish coatings can be textured according to the following methods:

1. **The stained coating:** The stained coating is finished with a float, as described above. According to the degree of smoothing desired, a wooden float is used for a regular finish, and a sponge float is used to obtain a smoother finish (141, 142).

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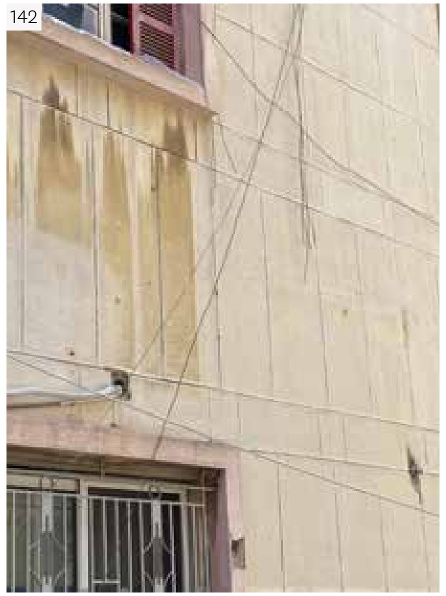

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2. The smooth and polished plaster (terrazzo, locally called *mosaic*): This type of plaster is chiefly used in common indoor areas: in skirting boards with a height of about 120 cm from the base of the walls and parapets of stairwells, landings, and hallways (144, 145). It is also sometimes applied to freestanding circular columns –especially those on the stilts of buildings. Highly resistant, the polished plaster retains its smoothness and does not require special upkeep from heavy wear or contact (146). Moreover, it can be washed with water. The plaster's junction with the upper part of the brushed wall is often highlighted by a stained and molded beech wood rod.

The mixture of the top layer of the terrazzo coating is made with white cement, stone powder, and fine aggregates (0 to 3 mm) of stone or marble depending on the desired shade and density. The sponge float topcoat will be about 10 mm thick. The surface is water-sprayed twice daily (in the morning and the evening) for 2-3 days so that it does not crack under the effect of removal. When the layer is dry (a week after laying), it is sanded to obtain a smooth and satin finish that exposes any aggregates on the surface of the coating.

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3. Tyrolean plaster: Tyrolean plaster is a granular finish coating obtained by spreading on the vertical walls with the aid of a zip line. This technique appears on the facades of some triple-arched houses in the early years of the twentieth century. The drawings and patterns, which can imitate stone beds or come in hexagonal patterns (nicknamed *zelehfe*, or turtle) (147, 148), are obtained by applying openwork wooden molds that are removed after spraying the plaster.

Cost-effective, durable, and practical, plain Tyrolean plaster is commonly found in the finish of the facades between the years 1935 and 1960. The widespread use gave the city's urbanism a uniform, sculpted look (149). Noteworthy, Tyrolean plaster was not applied to the walls accessible to passers-by because its granulated surface can be scratchy or even injurious to the touch. Moreover, the edges of the walls were often left smooth on a peripheral section with a width of 15 to 20 mm to keep them forming a clean line. This section is called *zamlé*.

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4. The crushed plaster: Commonly found in yellow or pink ochre finishes, crushed plaster is a benchmark of the late 1930s and 1940s. It is a Tyrolean coating on which the float (*melij*) is applied to flatten any roughness. The crushed surfaces are smooth and cloud-shaped –revealing hollow, granulated gaps (unlike plain Tyrolean plaster, crushed plaster surfaces are harmless due to the smoothness of the recessed parts) (150, 151, 152, 153).

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5. The bush-hammered plaster: The need to animate finishing plasters by reproducing as closely as possible stone masonry is revealed in the bush-hammered coatings popularized between 1945 and 1960. The light or ochre-color float finish is treated before it is completely dry. The desired effect is obtained by hitting the surface with a bush-hammer (*abouchard*) or a spade (*bîk*) for a *mzanbar* effect (154, 155, 156). To simulate stone fronts, joints were often drawn by scratching the surface of the plaster with a nail tip and a ruler in horizontal beds and alternating vertical lines. These seals also make it possible to coat the walls in stages, because coating in larger sections allows the surfaces to dry out before getting texturized, compromising the overall desired effect. The walls end with a smooth ribbon (*zamlé*) to prevent the bush-hammer from breaking the edges (154).

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6. The scratched plaster or *kratz*: Widely used in architecture between 1950 and 1965, the *kratz* is a thick, textured plaster that is scratched using an artisanal brush formed by embedding iron nails with protruding tips into a wooden float (157). This type of coating makes it possible to form surfaces (suspended planes or built masses) with a monolithic appearance.

The mixture of the topcoat includes white cement, stone or marble powder, and medium aggregates (4 to 10 mm) in the following proportions: 1 bag of white cement, 4 bags of stone or marble powder and 4 bags of aggregates (158). Some architects add broken glass to the aggregates for a sparkly look in the sun. The topcoat is 20 to 25 mm thick (part of which falls off during scratching). Before the coating is completely dry (about six to twelve hours after its application), it is scratched by rubbing the nail brush on its surface, until a compact, non-hurtful texture is obtained (159, 160).


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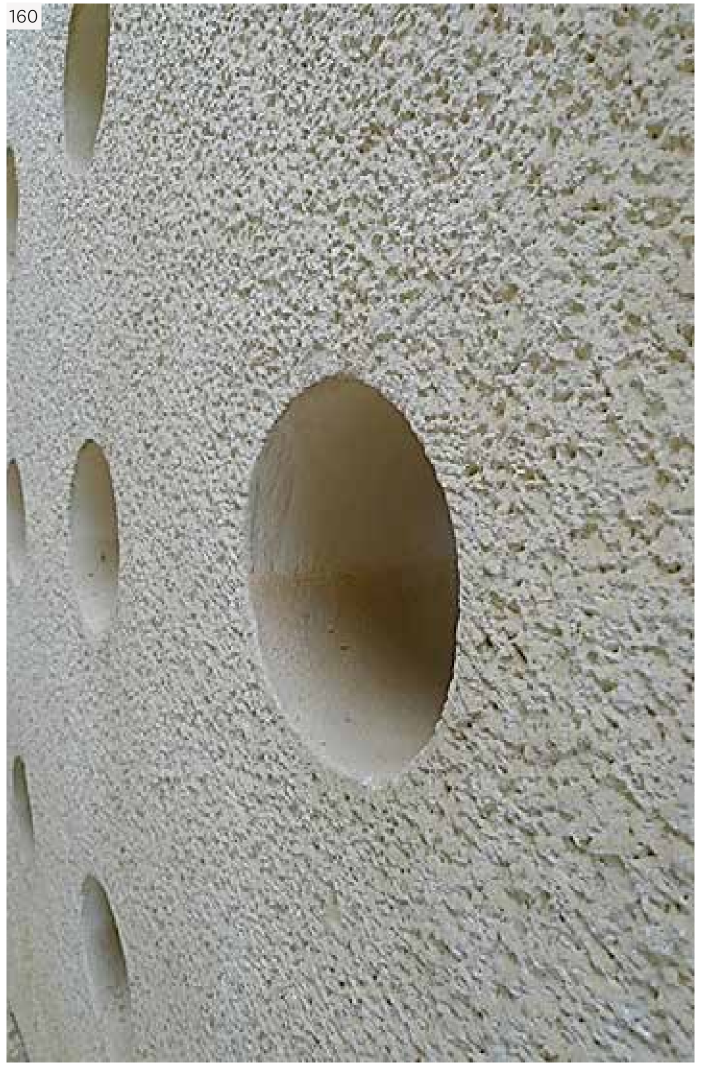
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Pathologies and treatment

Extremely tough and durable, tinted and textured finish coatings remained in use for nearly a century before they were abandoned some fifty years ago. Tinted and Textured surfaces are affected by two phenomena:

1. Dirt - Textured surfaces retain dust, pollution or bird droppings, and soils that become embedded in crevices over time and rainwater runoff. This pathology is the simplest to treat. The façade can be washed down with a low-pressure water jet so that its surface does not sustain any damage. Eventually, a soft brush can be used in addition to the water jet.

2. Breakage - The cracking or breakage of plaster comes from the wear of the reinforced concrete that supports it. The cracking happens due to the oxidation of steel reinforcements or the impact of bullet holes, shrapnel and other blows sustained during the civil war or the August 4th explosion (162, 163).

The surface of the plaster must be inspected, and all loose or detached parts should be removed. The causes of damage will be covered in following sections.

The edges of the plaster around the damaged part must be cut into fish bones (zigzag pattern) to create a key for the new coating. The three layers of plaster previously mentioned are then applied in accordance with the artistry and composition of the old plaster revealed by the detached parts. Finally, the topcoat should be treated so that it blends with the original coating.

AVOID: Do not apply a coat of paint to tinted or textured coatings. This may not only alter the building's look, but also runs a high risk of peeling off and can warrant the need for future maintenance. It is recommended to clean the plaster's surface with water and tolerate the residual traces of dirt that are too resistant to preserve the original patina of the facade.

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Although cement plasters pervaded the architecture of the 1930s to 1960s, other types of coatings were introduced during the 1950s to emphasize certain spaces, such as entrance halls or façade elements (164, 165). These coatings were either natural (stone, marble) or industrial (glass paste, ceramics). By introducing texture (through stone and marble) and color (through glass paste), architects were able to return to a less abstract expression than that which characterized buildings influenced by the Bauhaus.

Local stone and imported marbles were used to cover not only floors but also walls without a load-bearing function (166). They were added to decorate and embellish spaces with their strong materiality and striking colors. Often installed in the walls and on the ground floor, these elements mark the base of modern buildings and villas.


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The Stone

Skilled stone-cutting laborers were widely available in suburban and mountain villages at the time (167). The local limestone grew from artisanal quarries that provided the raw material for mountain houses overlooking Beirut. Its colors varied according to provenance, but the yellow ochre of *Mansourieh* stone was often preferred for two reasons: it was extracted from the nearby hills of the eastern suburbs of the capital; this stone offered a marked visual contrast with cement-based coatings. The visual contrast was further highlighted texturally by the bumpy treatment of its surface (*mbawwazz*). As trade and transport flourished, other types of stone, such as the pink stone of Shemlan, the white-gray stone of Keserwan, and the ochre stone of Abey, were popularized.

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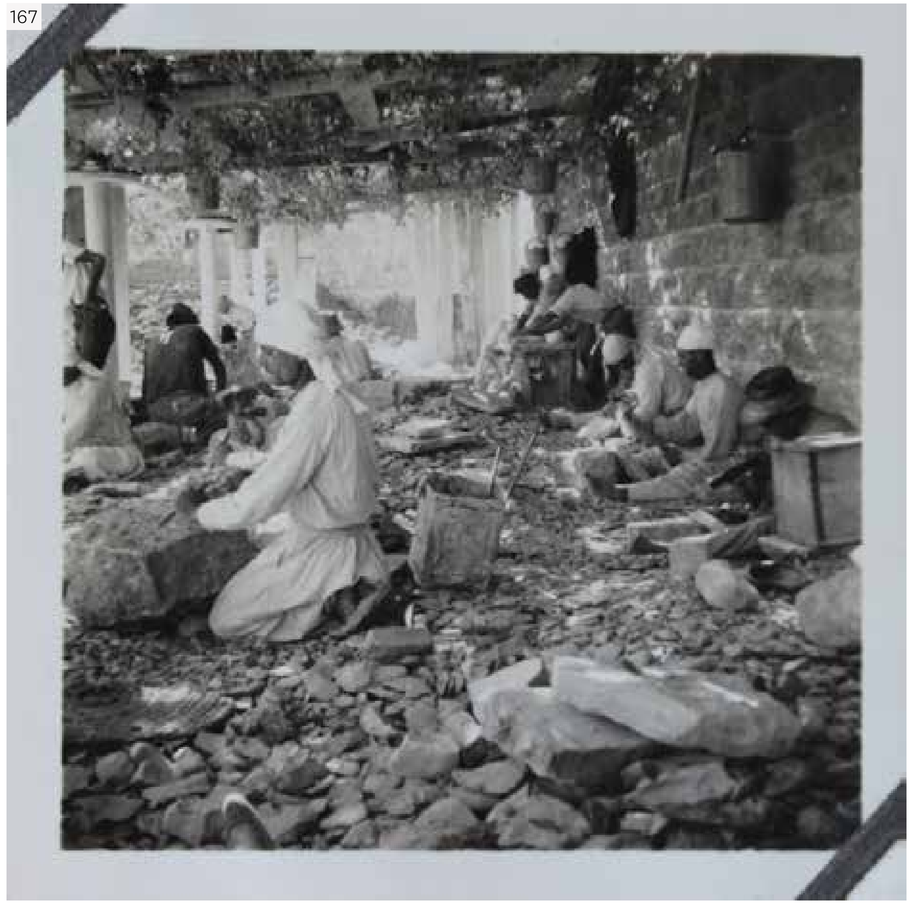

Installation techniques

Flooring : Local stone was used for the floors of garden spaces (terraces, steps, and paths). The stone blocks were roughed out then cut according to the drawing and instructions of the engineer/architect (168). Next, the surfaces were flattened and treated with a bush hammer (*abouchard*) so that they were not slippery (169). The lower part was worked with a diamond tip to be embedded in the substrate of powder, sand, and mortar.

Wall cladding: Applied to vertical walls at the base of the building, massive stone with a thickness of 8 to 15 cm was laid according to different free schemes (meaning that it did not have a load-bearing function here). The stone was then sealed to the wall with a cement mortar (*tîn*).

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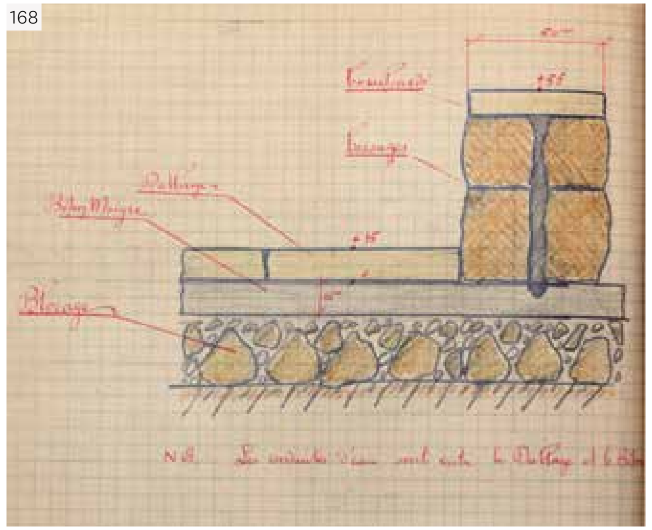

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The most common installation models were :

1. Vertical walls: Stones were laid in horizontal beds (*madamik*) of low height to affirm a direction that connects to the earth, with joints of minimal thickness or clearly marked (10 to 15 mm) and blocked with smoothed cement mortar (170).

2. Vertical walls: In alternating horizontal installation, stones of low height were nested against each other. This method of installation required stones from a hybrid laminate floor and alternating the layers of limestone with layers of sand or sediments. It was laid using sharp-edged dry joints (171).

3. Walls and floors in Roman Opus *(amerkéné)* : Rectangular or square stones of different dimensions were randomly placed to create a free composition with neither horizontal nor vertical dominance (172). The parts were separated by clean joints (10-15 mm thick) capped with smoothed cement mortar.

Sometimes, to enhance the installation's aesthetic appeal, various types of stone were integrated simultaneously, achieving a mixed color effect (white-gray, ochre, and black).

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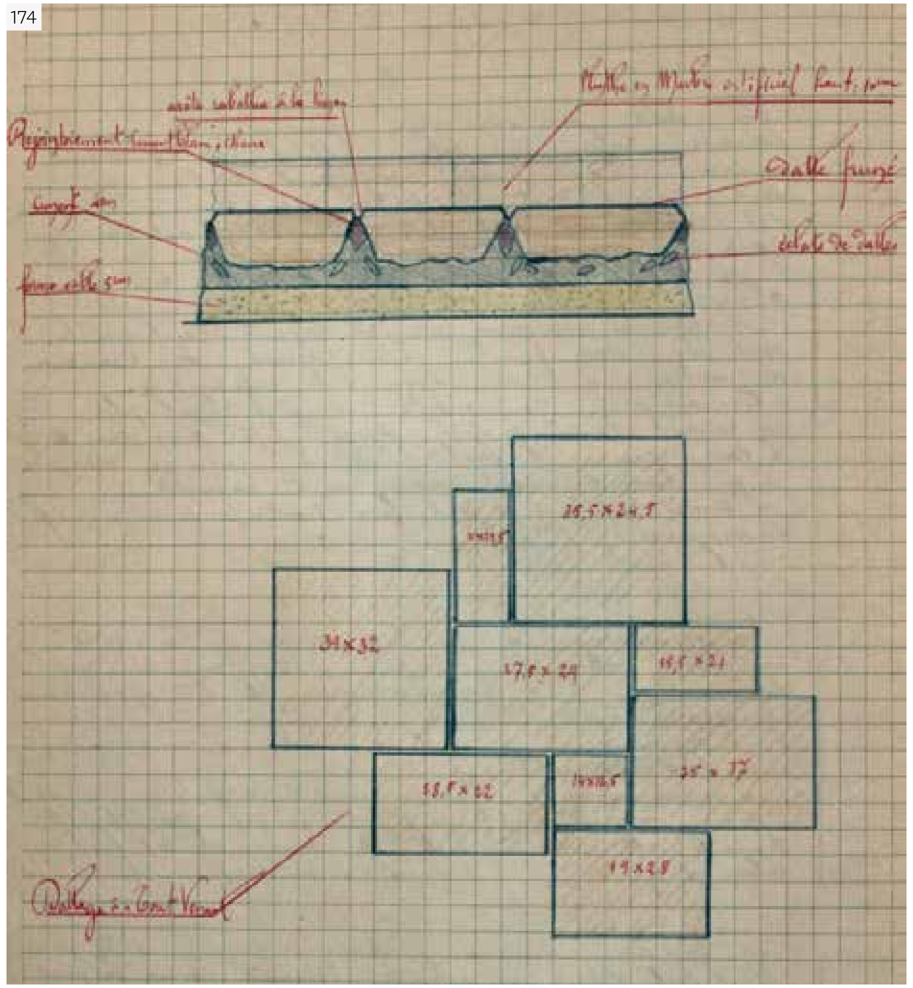
4. Walls and floors in Opus Incertum (*zelehfé* = turtle) or *Crazy Paving* (173, 175): Irregular polygonal stones were assembled freely using joints clogged with smoothed cement mortar about 15 mm wide. On vertical walls, this type of free laying instantly marks the non-load-bearing function of the stone and stands in contrast with the straight lines of modern architecture.

5. Floors: The tiles are laid in parallel strips with free joints. Sealed with cement mortar (*rawbé, kehlé*), the thickness of the joints varies according to the required model (174, 176).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Pathologies

Solid stone coatings do not show any particular pathologies due to the wear and tear of time. They may have been damaged by bullet impacts, shrapnel or metal debris during the civil war or on August 4, 2020, or by ground settlement. It is also common for the walls to be covered with graffiti or superimposed layers of posters and various leaflets applied with glue. Finally, organic dirt (animal waste, plant soiling, etc.) also sometimes altered the surface (177).

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178

Restoration and cleaning of stone coatings and floors [1]

- *Dry cleaning:* dirt, black crust, stains, calcareous deposits, cement puttying, incompatible materials, etc., primarily for vulnerable stones.
- *Humid basic cleaning:* Water is the most common and effective cleaning agent. However, if used unwisely, the building may appear clean on the outside but be rotting inside.
- *Low pressure cold waterjet cleaning:* The pressurized water from the waterjet can infiltrate through the joints and the porous sandstone reaching the structure. It is recommended to schedule water-based cleaning work during dry season. This allows the infiltrated water to dry faster. The level of pressure employed should be determined by a series of tests conducted on the stones prior to the actual cleaning work. While the depth of soiling only extends to a few microns in thickness on the surface, unmoderated use of pressure can bite deeply into the surface below, destroying the quality of the original banker mason's workmanship.
- *Water spays (nebulization and atomization):* They are one of the less abrasive methods. The best results are obtained through nebulization or better yet, the atomization of water using special nozzles that suit the soiled surface. Drops of water remove soluble composites. Due to the long time required by this method to be effective (1-2 days), it is advised to store big quantities of water. The procedure should be undertaken gradually, at regular intervals, and at a minimum external temperature of 14°Ce. Furthermore, the time of intervention should never exceed 4 consecutive hours of water spraying to avoid the excessive impregnation of the masonry.
- *Chemical methods:* If all the aforementioned methods fail, chemical cleaning methods can be used. These include applying liquids or poultices, using alkaline treatments, acidic treatments, or organic solvents, either individually or in combination. These methods require a higher degree of caution and expertise, as there is an increased risk for undesirable effects, such as the corrosion of the stone or the formation of soluble salts. Products for chemical cleaning are based on the application of reagents that attack the binding substances of the deposits. Reagents are usually salts (carbonates) of ammonium and sodium applied with supports of Japanese paper, compressed cellulose, or Attagel. The application's duration varies anywhere from 2 seconds to over 10 minutes depending on the material to be treated and the thickness of the crusts. A thorough cleansing should be applied to the stone's surfaces to wash off all chemical residue at the end of the operation. Otherwise, traces of efflorescence from the cleaning residue will appear on the surface in the form of white lines.

[1] *"Treatment of masonry surfaces", pp. 123-125, Nathalie Chahine Houses of Beirut 1860-1925. Restoration manual. Collection Cahiers d'architecture. Editions Al Ayn. 2021.*

179

180

Marbles

Until 1945, Carrara marble (*Carrara*) was used in flooring and skirting boards (181). In the 1950s, sources of supply diversified, and the market opened up to all types of marbles and their various colors. Italy remained Lebanon's primary source of marble due to it having its own local production and leadership in the international market. However, several other types and colors —the travertine (beige), the reds of Verona or Brescia (*shahem wa lahem)*, and the dark greens— joined the whites of Carrara and its derivatives (182, 183). People's taste for novelty and variety demonstrated itself in the 1960s by the use of rare and fragile marbles (onyx) or strongly colored (Rose "aurora") in prestigious areas.

Unlike more modest buildings where the cladding was made of terrazzo slabs and tiles, decorative marbles adorned the floors and walls of lobbies in high-end buildings. Further ahead, the high skirting (base) board and steps of prominent flights of stairs leading to the first two floors were also covered with marble (184, 185). On the other hand, beyond the first two flights, the steps and skirting boards were covered with terrazzo.

181


While it is possible to detect general trends stemming from the commercial diffusion of new materials and the varied tastes of builders and owners, the fact remains that novelty and diversification marked this new era. This upended past practices, such as when Carrara tiles were laid diagonally and applied uniformly throughout the interior during 1860-1935.

The 20 mm thick tiles supplied by local importers are laid on a bed of grey or white cement mortar for white or very light marbles. The surface is then machine polished until the desired shine is achieved.

182


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Pathologies

Coatings made of solid stone and marble slabs did not suffer particular pathologies due to the wear and tear of time. Rather, they may have been damaged by bullet holes, shrapnel, or metal debris during the Lebanese civil war, the August 4th blast, or by later ground settlements. It has also been common for walls to be covered with graffiti or superimposed layers of posters and leaflets. Finally, organic soiling (animal droppings, plant soiling, etc.) has also altered the coatings' surfaces sometimes.

184

185

Restoration and cleaning of marble coatings and floors [1]

- *Liquid cleaning:* Use distilled water or White spirit to remove spots of wax and/ or greasy dirt. Wipe over the surface thoroughly several times using swabs or sponges slightly dampened with water. Note that detergents might leave a residue on the surface which can increase the rate of re-soiling.
- *Dry cleaning:* For small spots, use a cleaning, natural rubber product, free from moisture, solvents, or chemical additives. Wrap it around the end of a bamboo stick, and roll it lightly over the surface.
- *Polishing and waxing:* If the marble has been damaged by treatment or by aging, it can get repolished with a succession of ever finer abrasives. Use small quantities of water as a lubricant to remove remaining residues and to hone the stone to a patina finish. Each stage reduces the roughness of the surface by abrading it away until the surface is smooth and glossy.
- *Dismantling and reinstalling in the same space (settlement problems) (186, 187):* Clean the marble with a soft tissue and remove all residue, while giving a code for each tile on the survey papers. Mark each tile with duct tape according to the coding system. Find a cracked stone to be the first tile to be gently removed. Carefully remove the grout around the tile without damaging the neighboring tiles, using a chisel or a flathead screwdriver and a hammer. The back of the marble should be cleaned by using a hammer and a trowel and soaking the tiles in water for about 30 minutes to soften the mortar if needed. Scrape off the mortar with a trowel and brush off remaining particles of mortar with a medium brush. The marble tiles should be stored in plastic boxes, with a geotextile between the tiles. The floor will consolidated, and will receive a new layer of sand ane lime mortar, before re-placing the tiles in their original location. For jointing, humidify the floor, then spread a grout with a well-dosed binder.

[1] *"Marble floors", p. 182, Nathalie Chahine*
Houses of Beirut 1860-1925. Restoration manual.
Collection Cahiers d'architecture. Editions Al Ayn. 2021.

186

187

Glass paste mosaics

Since ancient Rome, glass paste has been used in decorative arts and architecture. It became popular in Europe and America at the end of the nineteenth century and in the first half of the twentieth century in Art-Nouveau and Art-Deco architecture, facade cladding, and large decorative mosaic panels (188). The tesserae are created by mixing glass powder with a binder, molding them, and baking them at 800 degrees. It is a very durable facing, with a virtually unalterable surface. Produced on a large scale after WWII, particularly in Italy, it was introduced to Lebanon in the 1950s and would become a major cladding material in modernist architecture until the end of the 1960s. Aside from facade cladding, glass paste was commonly used as an interior for bathroom floors and walls (until today).

188

There are two applications for colored glass paste mosaics:

1- Use monochrome panels on facade elements such as balcony or window parapets and lintels, planters, cylindrical pilotis columns, and so on. While most architects stick to a single color (green-blue, bronze-aubergine, etc.) on the main facade, others will use a variety of primary colors to animate it (189, 190).

2- In figurative or abstract paintings, applied to a large section of the facade or a ground-floor front wall (188).

The tiles, pellets or hexagons are typically 20 mm on each side and are assembled into 30 x 30 cm sheets. These sheets are glued to the smoothed surface of the façade's cement.

189

190

Pathologies and their treatment

The surface of the glass paste tiles is durable and resistant to abrasion. As a result, the material and its colors have withstood the passage of time and natural elements, and typically only require surface cleaning to remove dust deposits. This cleaning will be done with damp cloths or with a low-pressure water jet (to avoid causing the tesserae to come off). Mosaics, on the other hand, suffer from two main pathologies:

1- Tesserae detachment: Some glass paste tiles have come off the surface due to the sealing glue's loss of adhesion.

2- The breakage of tesserae caused by the impact of bullets or shrapnel during violent acts (civil war, explosions of August 4, 2020, etc.) (191, 192).

191

In both cases, the missing or broken pieces must be replaced with tiles and tesserae of similar appearance and color. The abundance of international manufacturers and suppliers, as well as the material's market availability, will make it possible to find the colors and formats required to faithfully restore facades and interiors. Defective parts will be carefully removed one at a time. Brushing and washing will be used to remove all traces of old glue from the substrate. Along the way, we will ensure that the preserved tesserae adhere to the facade. Finally, the missing parts will be replaced by gluing new parts. The joints between tesserae will be cleaned by washing with low-pressure water. The joints between the old and new parts will be filled with a leveling product that is identical in appearance and color to the original.

192

As early as the 1920s, the use of industrial manufacturing and cement floor tiles spread. These tiles were of three types: the cemento, the terrazzo *(mosaic blatt),* and the porcelain stoneware.

The Cemento

The assembly of cemento tiles makes it possible to obtain colorful carpets of geometric shapes or floral interlacing. This type of tile is ubiquitous in buildings from the 1920s to 1935.

"Generally speaking, each room displays a different pattern consisting of a colored “carpet”, the centra, and a border of neutral cement. Tile patterns include oriental, floral, and geometric, among other motifs.

Manufacturing: The 20 x 20 cm tile has an overall thickness of 20 mm and was locally produced starting 1920s.

The cast-iron mold: It consists of a base, a frame, a model or forma imported from Europe, and a cover. The pattern is carved into the forma and set in the metal frame.

The mixture:

– The colored cement: consisting of a thin layer of white cement, stone powder or sand, and pigments, without any gravel or stone fragments.

– The foundation of the tile: consisting of stone powder, fine gravel, and black cement.

193

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– The semi-liquid colored mixture is poured into the indented compartments of the forma.

– The stone powder is sprinkled on the surface of the tile as a bonding agent, and the forma is lifted by its handle.

– The foundation of the tile is then poured.

– The tile is placed in a press before it is left to dry.

The color: The artisanal process was developed into an industrial production with a minimum of two and a maximum of seven colors (like the motif found in the *Daʿūq* Palace). The vivid cobalt blue was used more sparingly, as it was expensive.

Application: Tiles were always laid in a wet lime-based screed, and the skill of the tilers can be appreciated in the alignment and the setting out of the tiles. Grout lines are usually so fine that many people think these tiles were butted together." (p. 146-147) [1]

[1] *"Clay and decorated cement floor tiles", pp. 184-185, Nathalie Chahine Houses of Beirut, 1860-1925. Restoration manual. Collection Cahiers d'architecture. Editions Al Ayn. 2021.*

195

The terrazzo

Between 1935 and 1970, however, the industrial production of terrazzo (mosaic) tiles supplanted the use of cemento and marble for floor coverings. This was due in part to its largely advantageous cost, and also because it agreed with the simpler and more streamlined finishes prized by modernists (197). Terrazzo is a mixture of colored or uncolored cement and aggregates or marble scraps (196, 199). The standard size of tiles is 20 x 20 cm, and their thickness is 25–30 mm (197, 198). It is common to find tiles of larger dimensions (30 x 30 cm or 40 x 40 cm) in prestigious spaces, buildings' entryways, or living room spaces. The size of aggregates or pieces of marble varies according to demand. Once polished, terrazzo tiles reveal a surface of uniform color and texture.

Sometimes, architects would decorate parterres with tiles of two or even three different colors, laid in a checkerboard or carpet design with borders to enrich the appearance.

Extremely strong and durable, terrazzo tile floors will revert to their original sheen once polished. This type of flooring has fallen into disuse since the spread of pre-designed marble tiles at affordable prices, as well as the popularization of porcelain stoneware.


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The Porcelain Stoneware

Porcelain stoneware is a strong, durable, and non-absorbent industrial material. Imported from Europe during the second half of the 1930s, porcelain stoneware tiles were often used in either “noble” and service areas, or on all the floors of apartments and villas (200). The tiles are small (10 x 10 cm; 10 x 20 cm), of minimal thickness (8 to 10 mm), and come in various colors (grey, light ochre, brick or black, pale yellow, petrol blue, or green) (202, 203). Floor mats were often composed of an assembly of tiles of different colors in the Art-Deco spirit, checkerboard, or zigzag design. Later on, during the 1950s and 1960s, a free composition with dominant colors and randomly laid colored tiles came into fashion.

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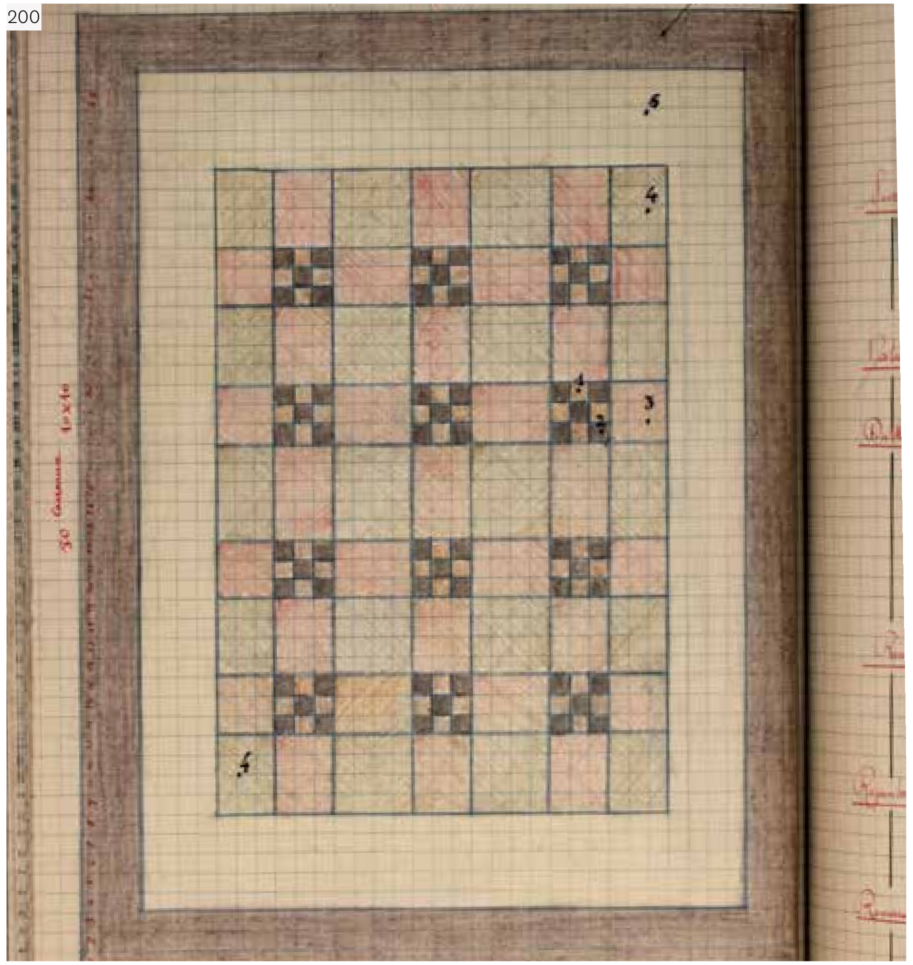

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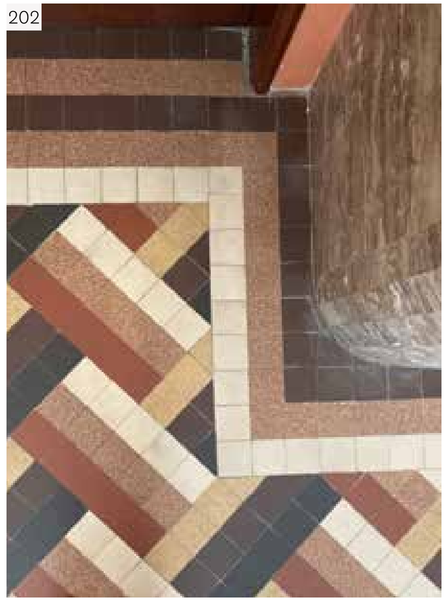

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Cleaning

Cemento, terrazzo, and porcelain stoneware tiles are all strong and durable. These industrial materials are inert, shock-resistant, and do not change color. Their small dimensions reduce the risk of breakage, and as a result, they do not suffer from the pathologies found on absorbent marble, stone, and terracotta tiles, whose surfaces scratch or flake over time. Thus, their restoration is often limited to a simple cleaning with clear water and a soft brush.

Precautions

While terrazzo can be polished at will, the same is not the case of cement or porcelain stoneware tiles. The decorative top layer of cement tiles is quite thin, and the repetitive passage of a polishing machine over its surface will alter the design and appearance by revealing its coarse-grained substrate. Similarly, the surface of porcelain stoneware tiles would be disfigured under a polishing machine and might suffer breakage. When necessary, cement or porcelain stoneware tiles can be cleaned with a rotary machine equipped with a felt *(lebbadé)*.

204

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206

OPENINGS: WINDOWS AND DOORS

Mazen Haïdar, Fadlallah Dagher

THE EVOLUTION OF PATIO DOORS AND BAY WINDOWS IN RESIDENTIAL ARCHITECTURE (1925-1955)

Mazen Haïdar

207

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The introduction of wooden folding shutters in the patio doors of the central hall was a major change in the residential architecture of the mid-1940s (207). Traditionally, the central space, or *dār,* was bathed in natural lighting streaming in from the large, triple-arched (or rectangular) bay windows. Wooden shutters were reserved only for other rooms in the apartment, such as bedrooms requiring more privacy. Starting from the second half of the 1940s, however, the use of wooden shutters became widespread across all chambers of the house. Equipped with foldable, multi-paneled shutters, the occupants' regular living space is in turn protected from the sun and wandering eyes alike (208). The new layout thus seems to establish a new relationship between the household and the outdoor space—one where a person can isolate themselves completely within the house.

The introduction of metal joinery is another indication of major novelty in the architecture of 1940–1955. The buildings analyzed in pericentral districts testify to the introduction of wrought iron into the bay windows of structures with central rooms. This is especially evident in the buildings where central spaces were lowered down from their original placement at the first floor and therefore more exposed to intrusion. Even after apartment plans abandoned centrality, bay windows in ornamented ironwork continued to characterize the reception areas of other rooms throughout the building and not only those of the first floor. A field survey makes it possible to date the use of these patio doors to the late 1940s. However, in the first half of the 1950s, this practice was abandoned in residential buildings in favor of newer models that coincided with the development of the metal chassis industry. During this period, new design parameters for residential architecture were implemented, and the use of iron frames allowed for an increase in the openings of the reception and living rooms along continuous balconies of high-end constructions, with a simple metal structure alternating between open and fixed elements. One of the earliest examples is evident in the Arida Building built between 1949 and 1951 by George Rais. We can also cite a second contemporary example in the Union Building built by Antoine Tabet and Lucien Cavro also between 1949 and 1953 (209). In these two key examples, the metal windows and bay windows were protected by wooden roller blinds; while in other cases, transparent surfaces were not supplemented by an obscuring device. Protection from the sun was therefore ensured by Venetian blinds made of aluminum slats placed on the inside.

209

The bay windows, which were first used in the living spaces on the main façade, exhibit a geometric sobriety accentuated by a reduced base and concealed on the outside by the balcony parapet. The transparency of these parts is only broken by ornamental elements added for security purposes on the ground and first floors, and sometimes even on the last accessible levels of the roof terrace. While steel structures were used in day areas, the French windows of bedrooms were made initially with wooden joinery (210). Other constructions completed between 1950 and 1955 testify to the indiscriminate installation of metal windows throughout the apartment, either with or without roller shutters (211).

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Fadlallah Dagher

Between 1925 and 1965, the rules of architectural composition underwent constant evolution as a result of several factors, including the academic training of an increasing number of engineers and architects; the introduction of the modern style in Beirut beginning in 1930; the dissemination of new ideas through publications and new materials; and the evolution of techniques. The facades are gradually liberated from the typical house composition with a central hall: asymmetry is essential and the windows are spaced out in length (215, 216, 217). Above all, arches are replaced with straight lines (after the Art-Deco transition) (214).

Important Note

The typical details and materials will be introduced below. However, due to the new creative freedom claimed by the builders, it is possible to encounter specific cases that we recommend carefully documenting.

Furthermore, because the manufacturing techniques have not changed and are still widely used today, we will not go into detail about the restoration stages. To preserve the architectural character of the work, we will recommend carefully observing and documenting the elements to be restored and taking care to preserve their characteristics, materials, manufacturing techniques, and proportions.

We can see an evolution in three stages, in which the artisanal manufacturing processes gradually decline in response to the rise of industries. The end of the artisanal era is also marked by the popularization of architectural creation and the construction quality.

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Windows

The composition of the plans and facades remains true to the typology of a central hall. The vertical rectangular *Qotrani* wooden windows (100 cm wide, 200 cm high) have two inner glazed leaves (topped by a glazed transom) and double-leaf shutters, with outside shades (218, 219, 220). The louver blades are frequently manually adjustable using a wooden rod. Mastic is used to secure the glazed panels to the frame.

The differences from the previous period are minor: the glazed panel is one piece that spans the height of the leaf and the width of the transom; the inside corners of the frames are rounded and beveled; the fixed frame shrinks in-depth and industrial accessories spread.

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Central Bays

The large bay window in the central hall retains its symmetrical design. The three arches are replaced by a unitary composition of a simpler design, divided vertically into three parts and resulting from the use of reinforced concrete rather than stone masonry: a large low-arch spanning the entire width of the central bay (221), a straight lintel, or an inverted staircase *(en escalier inversé)* (222)... Moorish geometric designs or those closer to Art-Deco simplicity replaced the interlacing ornamentation of Gothic inspiration (223).

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Doors

Doors are still mostly handcrafted, in the tradition of high doors with two narrow leaves (224, 225). The fixed and opening frames are made of solid *Qotrani* wood. Stiles and crosspieces support molded infill panels. These doors frequently have a glazed transom, which allows you to reduce the size of the opening leaves while still adhering to the classic rules of proportion. The upper part of the entrance doors has an integrated window. The glass is translucent and engraved, *mhajjar*.

The wooden parts of the windows and doors are assembled using tabs, stubs, and mortises in a traditional and artisanal manner.

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Accessories

Industrially manufactured in steel and cast iron, hinges, locks, handles, *cremone* bolts, and *espagnolette* are imported from France and Europe.


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Windows

Traditional composition and elaborate ornamentation were abandoned between 1935 and 1965. Straight running moldings at the spandrel and lintel level often accentuate the horizontal design of the windows. Steel joinery is introduced, but wood is still used. These two materials would coexist before being replaced by aluminum in the 1960s.

231

Carpentry in Wood

The wooden joinery in *Qotrani* or Romanian pine, *Soueidi,* is made up of two parts: wide interior leaves and exterior shutters that fold down like an accordion in several narrow parts (232). Mastic is used to secure the glazed tiles to the frame.

The service rooms on the mezzanine, as well as the bathrooms, are lit and ventilated by circular windows (231). They open in two halves, hinged at the central upright. Their panes are frequently translucent and rough, *mhajjar.*

Although the windows are hinged and swing, sliding joinery was introduced in the large bays that descend to the ground in the early 1950s. The sliding system allows for wider openings than traditional casements (233). A wooden frame and slide guide the openings, which are guided by a running groove in the lower and upper crosspieces (234). To eliminate the lower crosspiece as a traffic hazard, it is replaced with a wide solid stone threshold with stripes and grooves into which the sliding glass panel is inserted.

Tabs, stubs, and mortises are used to assemble the joinery. Industrial glues and screws will be introduced gradually to facilitate assembly and fixing.

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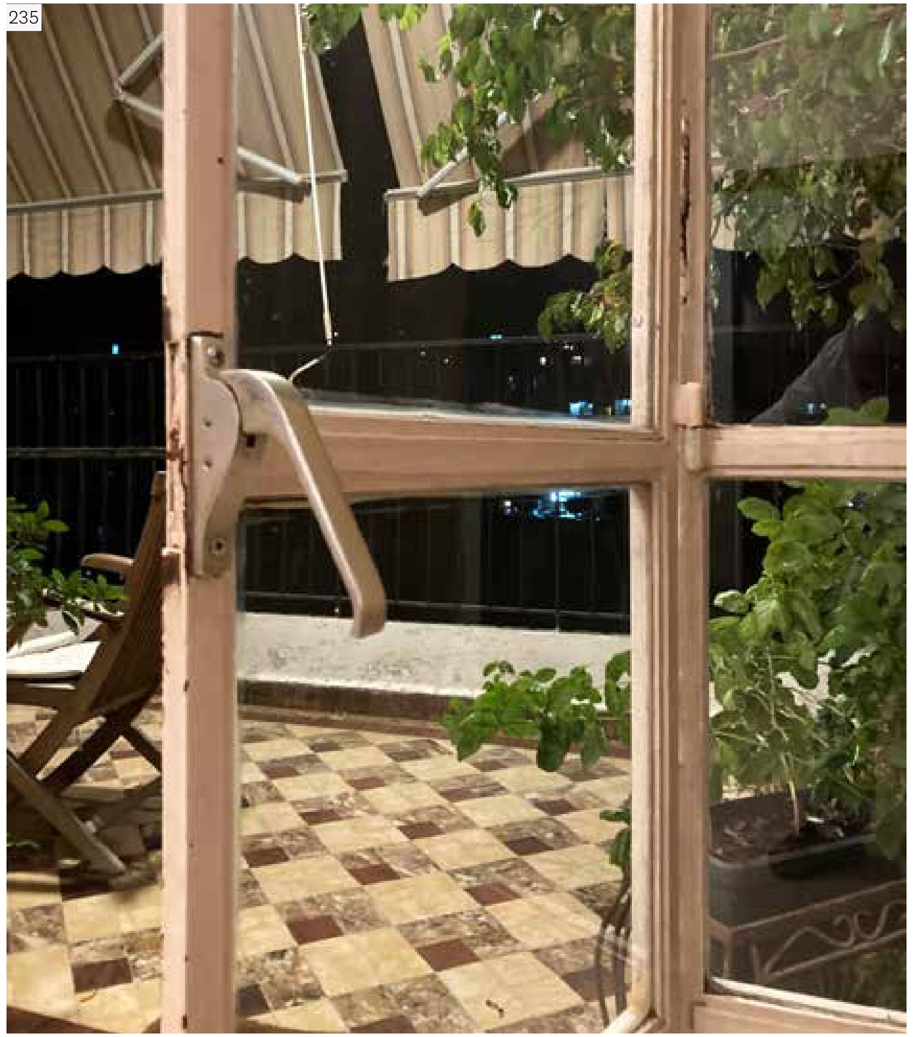
Steel joinery

Welded and painted steel joinery was introduced in Beirut in 1935 for large bays. Vertical and horizontal crossbars divide the thin frames of the leaves into squares (235, 236, 237, 238). Putty is used to secure the thin panes to the steel. The fineness of steel joinery in comparison to wood, the strength of steel, and the ease of manufacturing made possible by the introduction of welding, *hdédé franjieh,* will encourage the spread of metal windows.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Doors

As new industrial materials enter the market, traditional doors with stiles, transoms, and solid wood panels are gradually being replaced by modern models (plywood, blockboard, surface veneer, etc.). The fixed frames are constructed of solid wood (mahogany, beech, etc.). The leaves' solid wood structure supports a smooth industrial panel made of slatted wood. It is frequently clad in beech plywood. These doors are then painted or covered with a glossy, lustrous, or varnished natural wood veneer (mahogany, walnut, etc.). To soften the harshness of the modern lines, molded or brace beading is sometimes applied to the surface.

Industrial glues are required in the production of modern doors and cupboards with smooth finishes.

Because of imports of new species of solid wood and veneer sheets from Europe, Africa, America (North and South), and Asia, the *Qotrani* wood has been discontinued. Noble woods are sought after and highlighted by a colorless varnish. Certain low-end woods (pine, beech, American oak) will be tinted to imitate more noble or fashionable species: rosewood, walnut, mahogany, ebony, and so on, for economic reasons.

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Accessories

Steel or brass hinges, brass recessed locks, steel, brass or aluminum handles are all imported from industrialized countries, primarily Europe but also the United States.

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Blinds

Beginning in the late 1940s, blinds gradually replaced shutters. Industrially produced in thin strips of wood (Canadian Clear, Pine Douglas, etc.) joined together by brass staples, they are rolled up in a box and placed inside the house, above the window or the bay. The box frame is constructed from solid wood and plywood. The painted steel side rails are activated, causing the shutter to unfold and fold outwards (commonly referred to as Italian style). This device provides sun protection while also promoting ventilation (and, incidentally the view of the street below). The blinds are manually raised and lowered using bearings powered by chains or woven belts and, later, a crank handle. This modern system has several advantages: it is lighter, easier to handle and maintain, and it blends in aesthetically with the openings' increasingly smooth and orthogonal appearance.

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Windows and bay windows

Industrial joinery in anodized aluminum profiles was used in construction in the United States beginning in the 1930s. Pioneering manufacturers (Ajax, SCIALE) introduced the new material in Lebanon at the end of the 1950s. It began to replace the use of wood and steel in 1965, including for the production of roller shutters and bodyguards.

Industrial aluminum has numerous advantages, including being lighter than wood and steel, being weather resistant, not oxidizing, and requiring little maintenance. The profiles are put together with screws and industrialized accessories, and they slide on bearings or open with hinges. The proliferation of aluminum windows, on the other hand, sounded the death knell for artisanal construction, which had already been undermined since 1950.


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Doors

Industrial manufacturing methods for entrance and interior doors such as stuffing, gluing, and veneering, are gaining traction. Only a few craftsmen continue to use solid wood manufacturing techniques (nicknamed *njara `arabiyya* as opposed to *njara franjiyya*) and modern Western techniques.


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Pathologies and their treatment

Traditional *Qotrani* wood joinery (windows and doors)

Because of the durability of the resin-rich *Qotrani* cedar wood, these solid woodworks have withstood the passage of time and pests. Apart from the damage caused by civil war violence or the August 4, 2020 explosion, there are no specific pathologies to be noted. The damaged parts will be replaced as soon as possible, preferably with salvaged wood from non-repairable structures. Defective accessories will be repaired or replaced with identical salvage parts from the market.

Modern wood carpentry

a- Depending on their nature, the joinery of windows and openings in solid wood of various species is affected by time, parasites, and humidity. It will be necessary to identify the species of wood with the assistance of a carpenter and have the defective parts replaced with parts of the same species. The window will be stripped so that we can inspect the wood and remove the layers of paint that have accumulated over time. If necessary, the accessories will be replaced with market items.

b- Veneered woodworks are fragile and have generally not withstood the effects of time, parasites, and humidity due to their composite nature: the use of inappropriate or low-end species, the fragility of the veneer as well as filler wood in beech chipboard, and, most importantly, the aging of industrial glues. As a result, the humidity-induced cracking of the veneer sheets is visible. Therefore, it will be necessary to carefully examine all of the structure's components in order to assess their condition and decide whether to restore and renovate, or replace them. The recovery and preservation of original works will be encouraged. If replacement is unavoidable, great care will be taken to precisely replicate the details of the defective work using materials with similar properties. Depending on their condition and quality, the accessories will be reused.

Steel joinery

Humidity-induced oxidation (rust), as well as bullet or shrapnel impacts, can severely damage steel joinery. However, due to welding techniques and the availability of standard profiles on the market, their repair is relatively simple. However, the steel joinery from 1935 to 1960 conducts heat, and the accessories are frequently obsolete. As a result, it will be a matter of weighing the decision to be made during the restoration in accordance with the proportions desired by the designer. It should be noted that steel joinery should not be replaced with aluminum joinery. They do not have the same dimensions and could cause distortion in the work. It is possible to consider using contemporary steel joinery with a thermal break and double glazing.

Wooden blinds

The pathologies that affect wooden blinds are diverse: slat aging and deterioration, rusting of steel frames, bullets or shrapnel impacts, obsolescence of accessories and mechanisms (bearings, manual steel levers or belts cranks), lack of frame waterproofing, etc. It is recommended that these distinctive elements of 1950s and 1960s buildings be restored by skilled carpenters and locksmiths. If we can consider replacing the mechanisms and levers while preserving the work, we should avoid replacing the wood with aluminum slats, which are incompatible with the typical Italian opening, inseparable from the architectural spirit of Beirut's early modernism.

Aluminum joinery windows

Primitive aluminum profile joinery suffers primarily from the obsolescence of its accessories (bearings, seals) and their inability to accept double glazing for thermal insulation. If their replacement is required, it is best to select the most recent profile that is closest in section and color, so as not to mismatch the building or harm the character of the work.

ARCHITECTURAL IRONWORKS

Mazen Haïdar

During the second half of the 1930s, Beirut's buildings began displaying a variety of decorative features ranging from the simplest to the most elaborate on doors, windows, handrails and metal railings. With the composition of the façade often on the backburner of owners' minds, these design features served as spaces of creativity and unrestricted expression for architects, engineers and ironworkers alike.

Between 1925 and the late 1950s, the drawings of wrought ironworks seem to have oscillated between intricate compositions and basic geometric models. Remarkably, during the 1940s, complex models decorating the sleek facades coexisted with works that adopted, on the contrary, a language of notable simplicity.

259

The first examples of railings dating back to the period between 1925 and 1935 herald a surpassing of traditional means of expression. Although they remained vertical in nature for the first half of the 1920s, they witnessed remarkable changes in terms of style and execution. Dubbed "first eclectic models" by Robert Saliba[1], these models no longer comprised a simple assembly of disjointed scrolls that quickly grow out of fashion. Rather, the overall design and execution of the railings became sleeker and less fragmented. The consistency of their composition is emphasized by the adoption of the same steel section throughout the design (260). Its implementation - made possible thanks to electric welding - marked a new phase in the construction of corbelled balcony railings across the country (261). Malleable and suitable for all shapes, soft iron was manipulated by forgers using the new technique to create interconnected shapes while concealing assembly points. An examination of constructions dates these first models to the early 1920s. Henceforth, handlebars would gradually free themselves from garrison such as the steel balls crowning the corner pillars.

This development in execution facilitated the adoption of new configurations that brought forth a break with verticality in the decade extending from 1925 to 1935. Moving beyond mere practicality, guardrails and ironwork began incorporating various elaborate aspects to the vertical design. Among these, one may find the stylized flower basins of prominently French inspiration, as well as other models based on circular designs. In other cases, verticality is further reduced in favor of increasingly abstract expressions. In addition to helping spread European styles, electric welding assembly paved the way for the adoption of increasingly varied designs that were easily integrated into iron structures.

[1] SALIBA, Robert, *Beirut 1920-1940: Domestic Architecture Between Tradition and Modernity, Beirut, Order of Engineers and Architects, 1998.,* p.104.

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After the popularity of naturalistic figurations in the period between 1920 and 1940, the decorative language of ironwork is re-oriented towards a composition that gradually freed itself from any overload in the form of curved lines or floral motifs. On the façade, this change accompanied the transition from the corbelled balcony to the cantilevered structure (262, 263). Spindly or of reduced length, these balcony models are characterized by larger dimensions and a more pronounced protrusion. Moreover, with the introduction of solid parapet, the previous height limitation of guard railings opens the way to new design avenues. With the onset of the mid-1940s, architectural ironwork renounced graphically simple elements like wavy lines and scrolls. The tight wave system, which ran until the 1930s, gave way to more distended curved lines that ran from one end of a railing, door, or stair railing to the other. By multiplying the number of openwork spaces in the graphic composition, this method attributed an aerial aspect to the railings' overall structure, sometimes sacrificing sturdiness for elegance.

The second half of the 1940s ushered new changes in ironwork. The broadening of entrance doors in high-end buildings and the enlarged dimensions of continuous balconies favored the adoption of the repeated pattern as a primary principle of composition. Before the introduction of aluminum in the mid-1950s, entrance doors with two or more swings became the most noticeable wrought iron elements in Beirut after railings (265).

Some decorative recurrences accompanied the years between 1945 and 1955 in the city. Apart from the previously mentioned variants of curved or circular shapes, other geometric compositions may be noted. Among them are the various configurations formed from the interlacing of pivoted squares and diamonds that were inspired by contemporary French master ironworkers' creations [2] (264).

[2] HAÏDAR, Mazen, *La ferronnerie architecturale à Beyrouth au XXe siècle,*
Paris : Édition Geuthner, 2021, p. 94-97.


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Guidelines for the Intervention and Restoration of Wrought Iron Structures

Wrought iron structures manufactured during the French Mandate and until the end of the 1960s present several types of structural pathologies and weakening today. These can be categorized into: i) superficial degradation (268) ; ii) loss of ornamental or structural elements (267); and iii) the weakening of assembly and embedding points (266). Apart from these failures that are also detectable in works of traditional architecture, other categories of degradation or transformation can be reported on entrance doors, railings, and bay windows made of wrought iron between 1925 and 1970. These include the appearance of cement mortar residues, particularly on the ends of window grills and on horizontal railing bars placed directly on balcony parapets. It should also be noted that botched repair procedures, such as the superimposition of paint layers applied without stripping or corrosion treatment, have been used in certain cases. The same applies to the wrong application of layers of glazier's putty on windows and patio doors giving rise to rough and weakly resistant surfaces. Another recurring problem in constructions of later periods is the deterioration or disappearance of printed glass panels in some railings.

The conservation of wrought iron structures must first consider the oxidation of the material. Whether through manual or mechanical interventions, the stripping of existing paint layers or other types of residues should be the first step of this operation. Impurities such as traces of electric welding at assembly points do not necessarily represent components that must be removed in the intervention. However, sections with sharp edges that inconvenience the tactile experience can be smoothed out. Following this, an anti-rust coating is applied to prepare the work for restoration with the original chromatic definition, if it can be identified. Heavily corroded parts, such as door bases, can be replaced by new parts that faithfully reproduce the original composition. It should be noted, however, that such substitution operations must be reserved strictly as a last-case solution for irrecoverable surfaces only.

267

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The disappearance of structural or decorative elements of railings, doors, and windows can be addressed by an identical restitution that mimics the qualities of the missing parts such as thickness and finish. Decorative parts that are detached or whose shapes cannot be identified with precision may be excluded from this integration. Although it is desirable that damaged printed glass panels in railings or entrance doors be replaced by elements of the same finish, the adoption of tracked or striated translucent glass can represent an acceptable solution to the unavailability of the original decorated glass.

The stabilization of the embedding points must first deal with the corrosion of the wall studs that caused the cracking or the bursting of the concrete. In these situations, the recessed part must be partially or totally released and —if the case necessitates it— treated against oxidation or replaced by a new element of the same design. The sealing mortar used to integrate the missing parts of the wall must be chosen according to their adhesion and strength capabilities. The effectiveness of this mortar is measured by its resistance to shrinkage which is the lead cause for the decoupling of metal and concrete. Moreover, weakened assembly points can be stabilized by electric welding or riveting depending on the original bill. Vertical or horizontal bars that have undergone slight deformations that do not compromise the stability of the structure can be preserved as is. Certain characteristics specific to the production of architectural ironwork in Lebanon during 1940s-1960s are to be taken into consideration in any conservation intervention. Such elements include the polychromatic treatment of entrance doors, in which decorative elements such as stars and medallions were embellished with golden dyes or a dark yellow stain that resembled bronze (269). Finally, common additions to wrought iron works can be considered historical elements of the structure's evolution and worthy of conservation procedures similar to those reserved for the original parts. These additions include protective structures installed to increase the height of guardrails, drying racks welded into the grab bars to hang clothes, as well as the introduction of perforated metal (270), lock boxes, or other safety accessories to the front doors.

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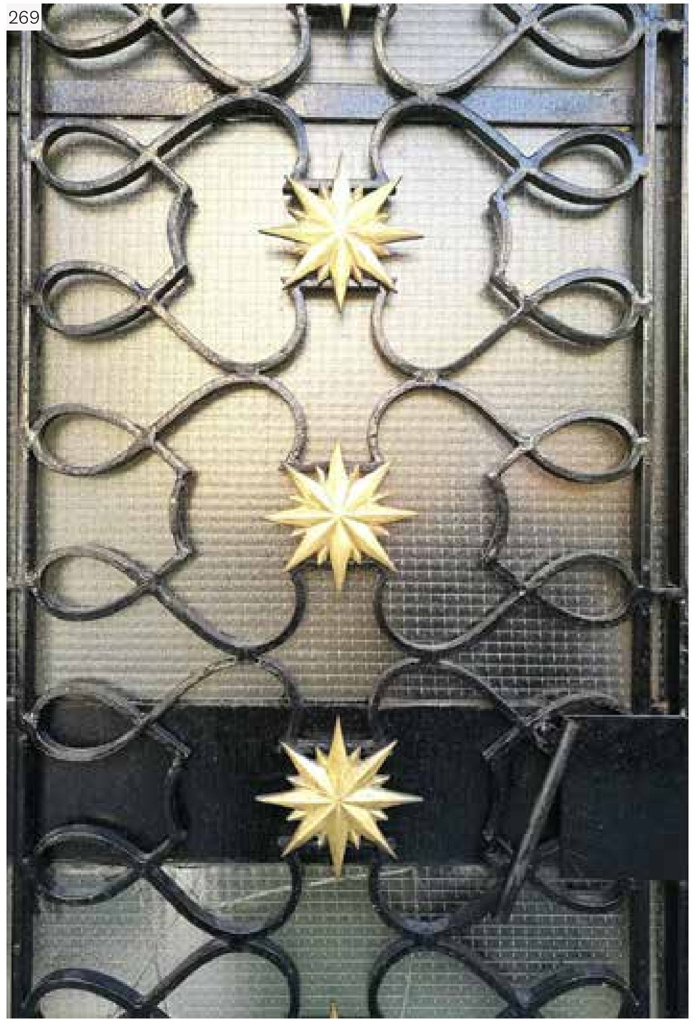

270

HEATING AND AIR COOLING

Aram Yeretzian

Extending the life of buildings

"The existing building is tomorrow's new building material. It's about considering the existing as a resource and as a value – and not about always seeing it as unsatisfactory and too constraining."

Anne Lacaton (Lacaton & Vassal Architectes)

Passive design of modern building

The design of traditional and early modern buildings (1830s to 1930s) accounted for and responded to contextual geographical, climatic, social and economic parameters. With time, new technologies were introduced into the building industry, and the occupancy of spaces changed. Consequently, passive design strategies were deprioritized in favor of more active cooling and heating devices. This led to thermally and visually less comfortable spaces that, in turn, resulted in increased energy consumption and CO2 emissions. In addition, such developments resulted in the deterioration of the environmental dimensions of buildings and the spaces between them. The following section highlights the importance of older buildings and presents guidelines relating to energy-efficient renovation methods.

A multi-disciplinary team

The thorough study of a building's status and potential requires an interdisciplinary team that would address the following aspects in an integrated manner:

- Optimized passive strategies (solar radiation, wind flow, daylight)

- Energy-efficient envelope (opaque walls, windows, moisture transport, shading, thermal bridges, air tightness, etc.)

- Enhanced artificial light

- Efficient active systems (this includes the assessment of potential energy production)

Within this framework, there are two aspects requiring consideration:

1. The passive design intervention: which focuses on the consolidation of the building by understanding its original performance characteristics. This includes studying the thermo-physical properties of the materials and the possible modification of these materials in order to enhance performance. Finally, addressing occupancy patterns and occupant behavior is critical to ensure an intervention that complies with both present and future requirements.
2. The active design intervention which necessitates studying the efficiency of cooling and heating systems, plug loads and the potential for renewable energy.

Degrees of intervention

A proper survey of the site's conditions allows the establishment of the most suitable remedial measures.

– Preservation: i.e. repair in order to keep the building in its existing state.

– Restoration: i.e. reviving the original aspect of a building using original materials

– Consolidation: i.e. employing supportive (original) materials to ensure the building's structural integrity.

– Reconstruction: i.e. re-constructing a building to maintain its genuine aspect.

Whichever approach is adopted, the following factors must be also considered to ensure the application of a comprehensive methodology: climate, building typology, use and occupancy pattern, infrastructure planning, the building's construction regulations and/or heritage protection directives, as well as construction materials.

271

The building

For older buildings, it is useful to understand the reasons behind the particular design and construction of the property. This includes denoting the building’s context at the time of its design/construction. In addition to marking its adjacent buildings, vegetation, etc., a comprehensive understanding of a building’s context encompasses such factors like solar radiation, wind flow and daylight.

Identifying the current uses and projected future requirements of a space also inform the design team in the planning phase —allowing the best-suited strategies to be considered, studied and integrated.

The envelope component

The Intergovernmental Panel on Climate Change defines the thermal envelope as being “the shell of the building as a barrier to unwanted heat or mass transfer between the interior of the building and the outside conditions”[1]

A building's envelope must meet a variety of environmental standards, including thermal, visual, and acoustic requirements. As such, it must satisfy the criteria of water penetration and air infiltration, as well as other issues.

[1] *6.4.2 Thermal envelope - AR4 WGIII Chapter 6: Residential and commercial buildings*, no date.


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Thermal performance is of particular significance because human thermal comfort is mainly related to the internal surface temperatures of the envelope components. The following factors and indicators are integral to understanding and assessing this issue:

- Construction materials of the walls. From the period extending 1830 to 1930, the following wall types were used, in chronological order:

  - Solid sandstone bearing walls that have lime plaster on the interior side (272);
  - Solid sandstone bearing walls that have lime plaster on both the interior and exterior sides (273).
  - Solid sandstone walls within a post and lintel concrete structure (274),
  - Solid cast in-situ reinforced concrete walls that have cement plaster and paint on both sides (275).

- Thermal mass and/or thermal insulation

Thermal mass (similar to very thick vernacular natural stone “Kellin” walls) slows the propagation of heat, while thermal insulation (similar to a refrigerator or a thermos) prevents heat flow. Deciding on the appropriate approach —be it thermal mass or thermal insulation— requires studying the dynamic behavior of the enveloping component.

In terms of insulation, one of two main application methods is recommended depending on the building’s performance requirements and the precedence of its architectural expression.

- Internal insulation is usually proposed when the external aesthetic aspect of the building is valuable and must be maintained. Although this installation is relatively easier, problems of thermal bridging must be resolved (see pages 212-213).
- External insulation is more efficient because it covers the entire structure. However, the first issue arising from such an intervention is that a new aesthetic will be created. The other issue is cost of its implementation.

In either approach (internal or external insulation), all opening jambs, heads and sills must be detailed and executed to avoid thermal bridging. Values for the thermal transmittance (U-value) of walls should be around 1 W/m2 °K or less [2] .

[2] *This value is recommended even though the Thermal Standards for Buildings in Lebanon allows for higher, less performant U-values.*


274


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Moreover, the degree of air tightness also needs to adhere to the adopted intervention strategies.

– Thermal Time Lag (TTL) and Decrement Factor (DF)

These two parameters allow understanding and determining the heat storage capacities of materials. Heat storage capacity affects a wall's internal surface temperature and, in turn, indoor thermal conditions. TTL represents the time it takes for the heat wave to propagate from a wall's outer surface towards its inner surface (Asan, 2006). The decreasing ratio of the heat wave's amplitude during this process is known as the DF. In hot climates, building envelopes with high TTLs and small DFs improves indoor thermal comfort (Rathore, Shukla and Gupta, 2020).

The glazed components

Glazed components (doors and windows) are a critical component of a building's envelope.

- Glazing: The glazing component should comply with current standards and benefit from the technological advances in the industry while respecting the architectural aspect of openings in old buildings. As such, instead of 6 mm clear float glass (U-value of 5.8 W/m2 °K), the industry today offers Insulated Glass Units that have a U-value well below 1 W/m2 °K.
- Frames: The material and performance of the opening frames could significantly affect the overall performance of the building's envelope. This becomes particularly important when the openings are smaller in size and the ratio of frames to glazing is high. In addition to choosing the proper material to ensure consistency with- and respect of- the old building, the issue of thermal transmittance should be considered. For instance, during cold weather, metal frames that conduct heat result in condensation on internal surfaces, while other materials perform differently because they have lower conductance. As such, if metal frames are selected, it would be preferable to choose thermally broken profiles so that heat does not flow easily within the structure.

The active mechanical systems

Mechanical systems of heating, cooling and ventilation usually have a life span of around 25 years. In addition to the various issues mentioned above, the following aspects should be addressed when inspecting existing buildings: :

- During the lifetime of a system, adhering to the manufacturers' instructions for repair and maintenance is important to maintain its efficacy. This would extend the lifetime of these systems.
- Replacing older systems with newer, more efficient ones must take into account aesthetic considerations regarding the components' location, the pipes, the ducts, etc.
- The proposed system should consider that ventilation is a key element in regulating indoor humidity levels. Lower humidity levels keep the building's fabric intact and enhance the overall health and comfort of its occupants.
- Depending on a building's typology, different options can be explored to specify the most suitable system. Besides the actual mechanical components (centralized, decentralized, window box type, etc.), building certain spatial components (such as staircases, wells, corridors, etc.) could contribute to the ventilation strategies.
- Initial and operational costs are integral to the selection of the most efficient system.


278


279

Construction in the 1920s

The integration of numerous passive strategies resulted in spaces that would provide thermal comfort to the occupants. Understanding the efficacy of such strategies requires thinking about their context at the time of construction. Buildings back then enjoyed less dense surroundings, more vegetation, low building height, etc. In terms of materials, the beginning of the 20th century in Beirut saw no change in the use of sandstone to construct walls (280).

These natural stone walls had a thickness ranging from 25 to 35 cm. A layer of lime plaster was applied to the internal and external surfaces (281, 282). The thick wall provided the necessary thermal mass to reduce fluctuations in the surface temperatures of internal walls. This improved indoor thermal comfort. Moreover, exterior wooden shutters were divided to allow wind flow while blocking heat from solar radiation simultaneously, open shutters at high-level windows would allow quality natural light into the spaces (276, 277).

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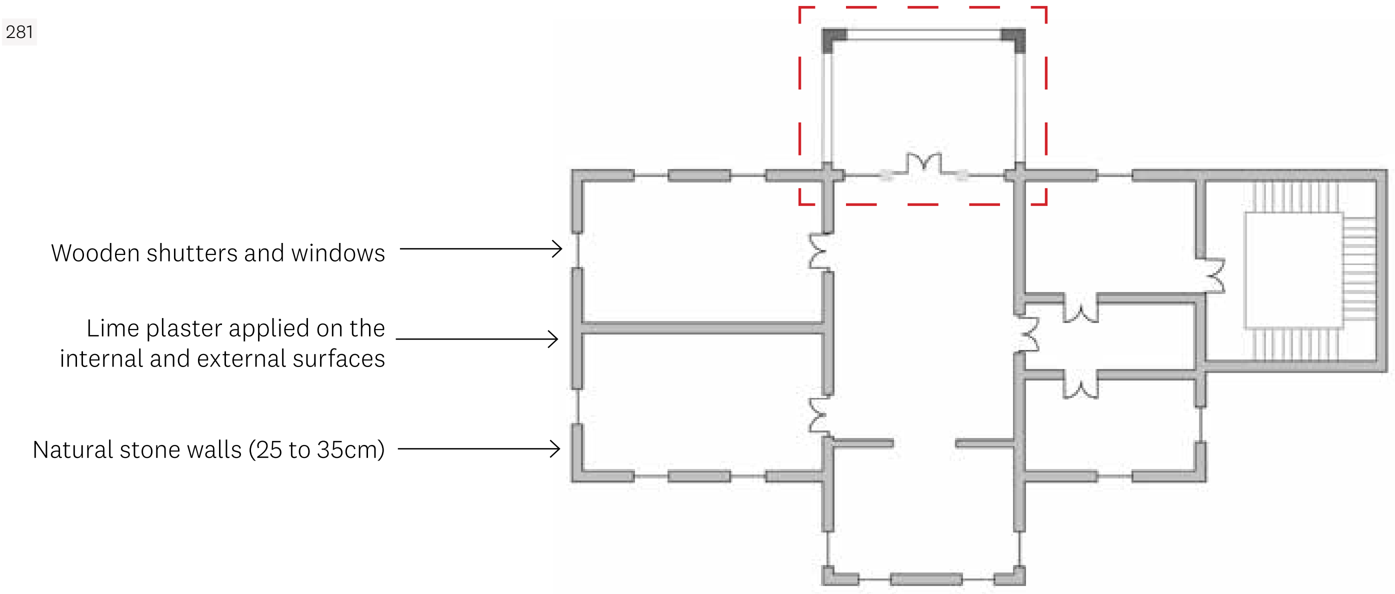

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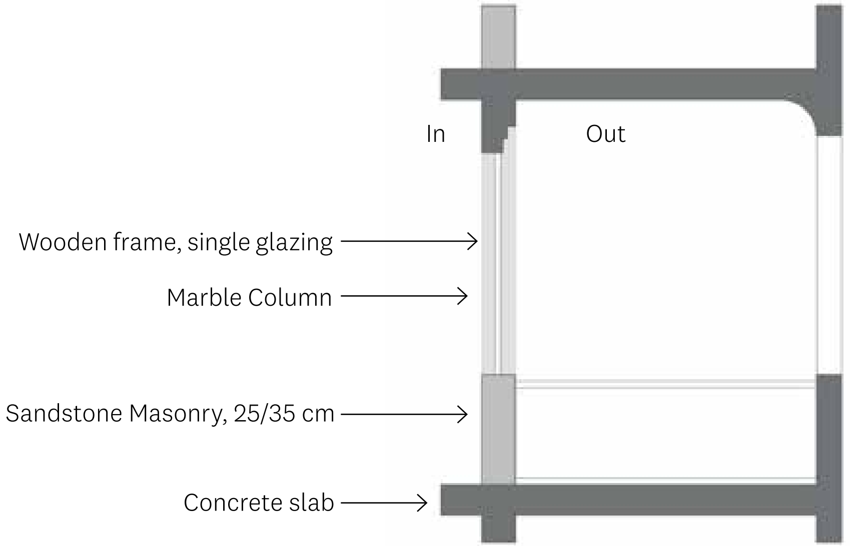

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Construction int the 1930s

During the 1930s, the introduction of cement into the building industry resulted in the erection of multi-storied buildings. Since mechanical systems were not yet available in the local market, buildings had to integrate passive strategies into their designs. The building in figure 284 illustrates some of these climate-responsive features. Each level of this multi-storied building contains an independent apartment, where the typology of the apartment is similar to- and based on the central hall house of Lebanon (285, 286).

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Spatial organization

Most of the spaces have two openings, which allows for efficient and natural cross-ventilation. The central living space also has two-sided (north/south) exposure—allowing for natural wind flow (287).

The main large openings are positioned north and south, which are advantageous orientations as per the altitude and azimuth of the solar radiation in this latitude. The large openings facing south are also shaded by the balcony components. Windows facing east and west are smaller to reduce incident solar radiation into the spaces. Today, with the addition of adjacent buildings, the openings are further shaded but less exposed to the prevailing winds that provide natural ventilation.

Building envelope

In general, the walls were built out of sandstone and finished with painted sand/lime plaster. The low thermal mass is advantageous in milder weather or when outdoor ambient temperatures are comfortable (i.e., during the spring and autumn seasons). However, it causes significant thermal discomfort during hot or cold weather.

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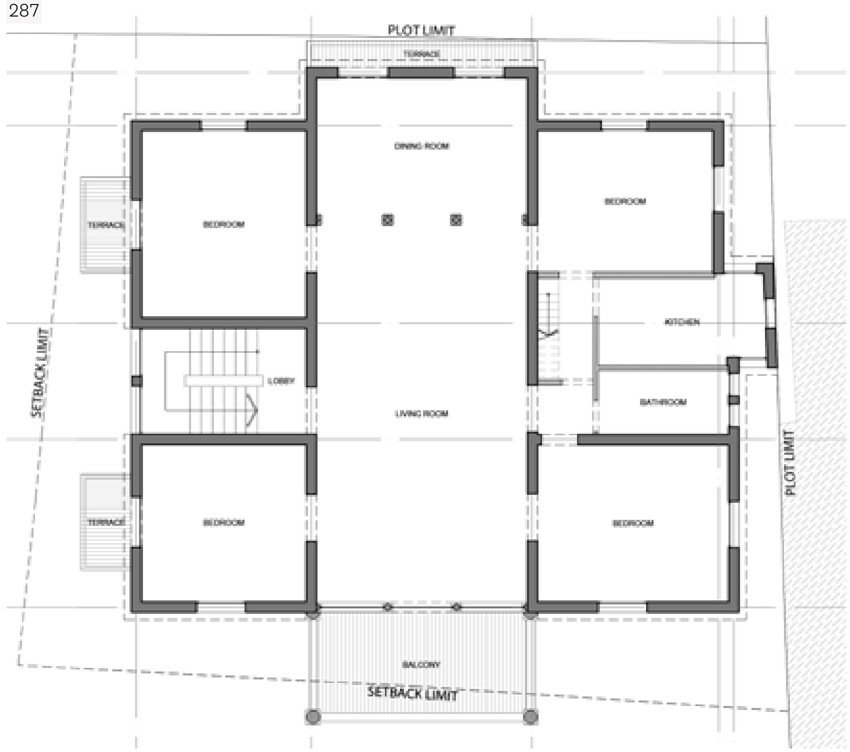

After the 1930s

Although construction materials were changing, passive strategies guided the design and construction in numerous buildings. As shown in figure 291, tactics like thermal zoning (orientation of spaces in accordance with the movement of the sun: e.g. bedrooms and the kitchen receiving the morning/noon sun) and accounting for wind flow (e.g. location of the kitchen so that prevailing winds for the south-west do not result in the propagation of smells, contaminants, and humidity into the apartment) enhanced indoor thermal comfort for inhabitants. The provision of more than one window in each space also improved wind flow in the spaces, rendering them more thermally comfortable when weather conditions allowed.

As of the 1930s and throughout the next decades, the use of cement (and concrete) became widespread, and walls were constructed with cast concrete. Including the sand/cement plaster and paint applied to the internal and external surfaces, the total thickness of the average wall ranged from 13 to 15 cm (290). Having a low thermal mass, this type of wall resulted in significant internal surface temperature fluctuations. Such wall behavior makes people feel thermally uncomfortable during the warm/hot months (in Beirut) and the cold months (in the mountains).

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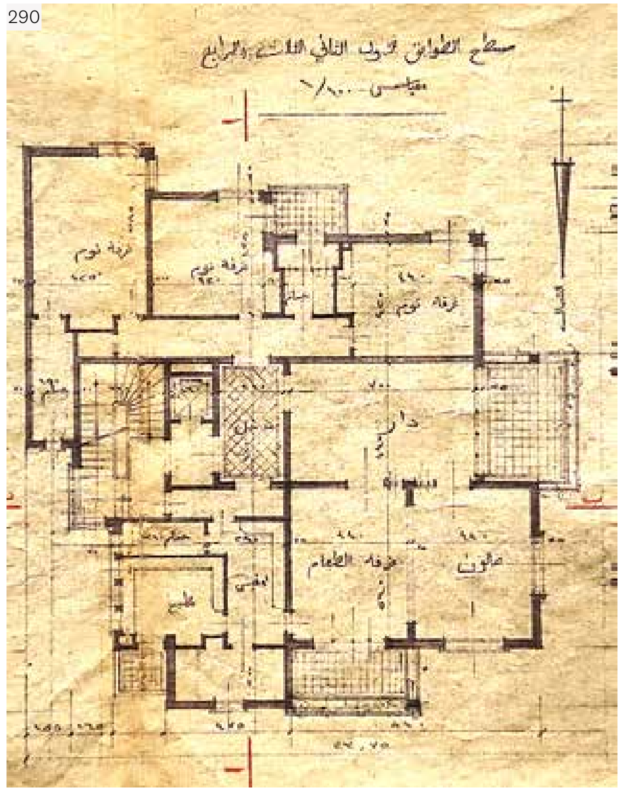

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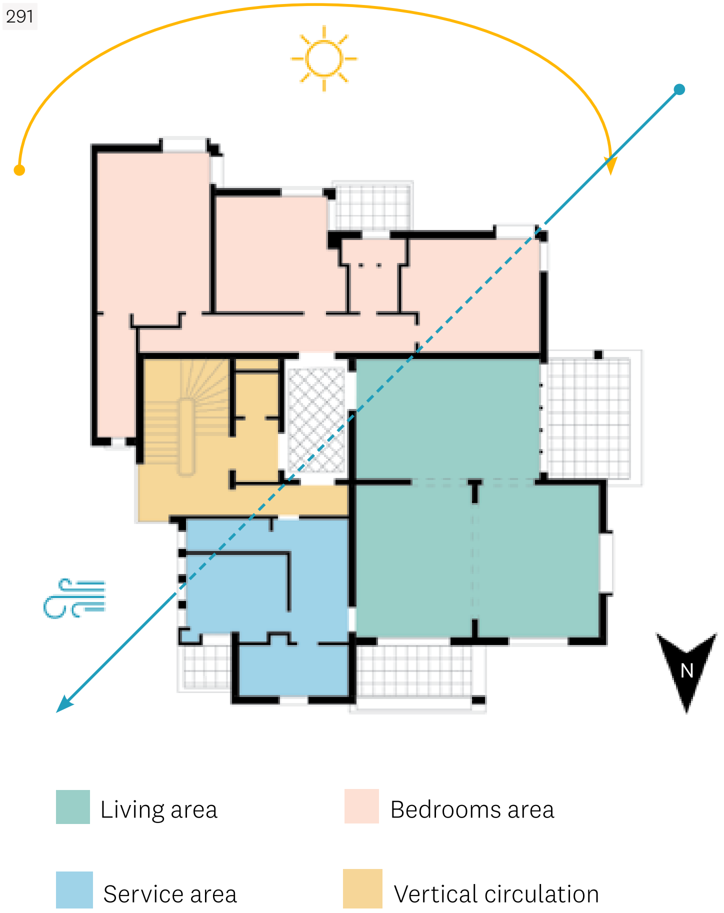

In addition to the numerous issues of structure, policy, regulation, etc. that are associated with old buildings, the following factors are integral to the building's fabric and should be addressed:

Envelope walls (292)

- Heat flow: as per sections 1 and 2, heat flow through the opaque envelope walls needs to be studied so that their performance complies with applicable standards. In addition, a thorough study of the envelope would consider the walls' orientation (facing north, south, east, etc.) whereby not all walls will require the same treatment and renovation measures. A comprehensive study also examines:

- Thermal bridging and condensation: All envelope components that are in contact with the indoor and outdoor environments present risks due to thermal bridging. Such components include beams, slab edges, opening lintels , window and door frames, etc. Mostly during winter, when it is relatively cold outside, humidity generated indoors comes in contact with the component, resulting in surface condensation. This produces mold that has adverse effects on health. Proper ventilation is one way to mitigate this. The same phenomena may happen inside the cavity of a wall— causing what is known as interstitial condensation. Although they are more difficult to identify and fix, these problems can be overcome by calculating and simulating the expected distribution of and variations in temperature and relative humidity of the envelope walls.

- Glazed components: Windows are particularly critical elements in the external envelope. In addition to thermal comfort (drafts, heat/radiation gains and losses), issues of health (condensation, mold) and air tightness should be resolved. Glass windows and doors built during the first half of the 20th century (up to the 1980s) have performance levels well below current standards in the building industry. While the renovation should ensure compliance with present-day performance criteria, upgrading these components should not compromise the architectural aspect of a building. Moreover, particular attention should be directed towards the visual transmittance of the glazed components so that the quality of indoor daylight is not compromised. Otherwise, occupants would revert to using artificial lighting which —in addition to other disadvantages— would increase energy demand throughout the lifetime of the building.

- Shading: Protecting glazing from incident solar radiation is an effective strategy to reduce cooling loads. Before considering the addition of shading devices as per the different orientations, the protection of thick envelope walls can be considered.

Internal artificial lighting plug loads

The selection of suitable internal lighting hinges on many factors. Efficient lighting relates to the architectural intent to express a particular spatial character and external aspect. In addition, it must comply with the occupants' requirements and a space's intended use (residential, administrative, commercial, etc.). Visual comfort, which can enhance the quality of spatial perception, depends on the type of fixture luminance, illuminance, and spectral distribution, as well as the reflectivity of indoor materials. It should be noted that a careful lighting design can reduce the demand for extra lighting and lower energy consumption. The same is applicable to the choice of appliances.

Materials

An important aspect of energy efficient and environmentally friendly reconstruction/ renovation is the specification of materials. Assessing the performance of the construction materials mandates a thorough understanding and assessment of each material's embodied energy (EE). A material's EE is the energy needed to process the material throughout its lifetime:

In addition to the energy required to process the material in the four stages, it is essential to factor in the transport component— which can make a big difference depending on the distances that need to be traveled. Finally, given the extended lifetime of a building, one needs to factor in the energy required to maintain the material.

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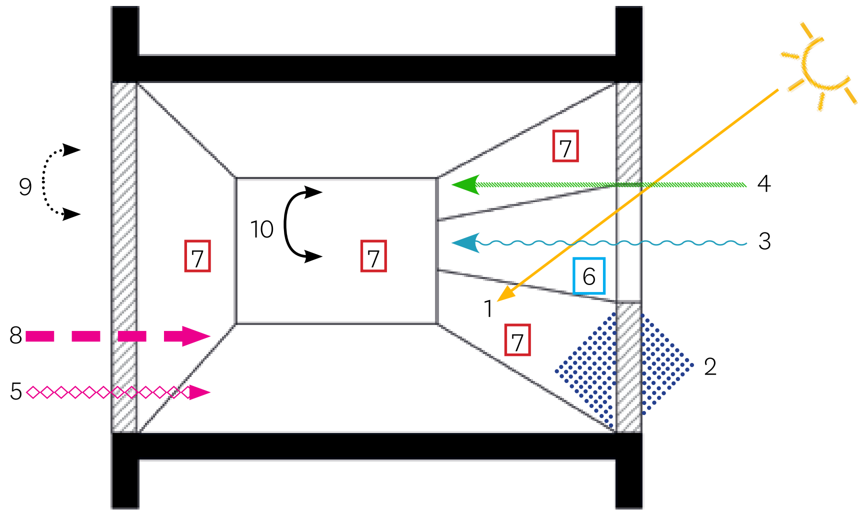

1- Solar gain
2- Humidity
3- Ventilation
4- Infiltration
5- Thermal transmittance
6- Glazing area
7- Surface temperatures
8- Thermal mass
9- External temperature
10- Internal temperature

EVOLUTION OF THE COMMON SPACES

Naji Assi, Yasmine El-Majzoub

Naji Assi

293


294


Entrance Hall

Buildings' entrances changed dramatically between 1925 and 1970.

They progress from being a minimal functional space to a generous lobby designed and crafted with noble and long-lasting materials.

- Between 1925 and 1945, entrances were limited to the space of the staircase itself, with a landscaped alleyway connecting the parcel limit entrance gate to the staircase/entrance. The alleyway is frequently tangent to the garden of the house on the ground level (293, 294).

- In the late 1940s, this alleyway was occasionally shaded by a canopy supported by thin columns or cantilevered.

- Buildings from the 1950s to the 1970s are distinguished by a large entrance hall that is frequently designed as a continuation of the exterior covered entrance or *pilotis* floor (295, 296). Some early examples had no separating enclosure and were completely integrated with the exterior space. The entrance hall's elements all contributed to its spatial quality, which was based on the concept of continuity between outside and inside. Stone or marble are used to finish the floors, and rough plaster *(kratz)* is used to cover the walls, which are then clad with stone, marble, or mosaics. Murals or paintings may be used to emphasize the spatial role of a specific wall in some cases. Aside from the abundant natural light, artificial lighting was frequently incorporated within a concrete or gypsum suspended ceiling, becoming an integral part of the architecture.

Entrance halls and lobbies should be restored in the spirit of their spatial qualities, which may include incorporating additional elements to meet accessibility and security requirements such as gates, doors, ramps, handrails, and so on. Existing materials should be meticulously listed and classified based on key performance criteria such as light versus dark, smooth versus rough, polished versus honed, and so on. If an old material is no longer available, choose a material that is equivalent in terms of specifications and spatial performance.

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Stairs

Up until the 1970s, staircases were regarded as a continuation of the entrance and a primary element of common areas. This was communicated through spatial quality and material specifications. Stairs had wide and generous flights with a gentle slope that provided a comfortable path for vertical circulation. Vertical windows were frequently used to bring natural light into the staircases and landings of the apartments (299, 302). The materials used in the staircase were chosen to respond to the functionality of each element and to withstand heavy traffic and repeated cleaning:

- The terrazzo, stone, or marble treads and risers were pre-cast (300, 301).
- Steel, wood, PVC, or aluminum handrails were used (304, 305, 306, 307).
- For added protection, walls were sometimes covered with terrazzo up to balustrade height (303).

Stairs should be rehabilitated while retaining their spatial qualities, which include dimensions and height clearances, materials, and natural lighting. When repairing the tread-riser in any part of the staircase, make sure to keep the initial details in mind, especially the tread nose or the riser slope if applicable.

In the event of structural defects, and because stairs play an important role in the overall structure of the building (shear walls), consulting with a structural engineer is highly recommended.

When adding an elevator, it is critical to maintain the spatial qualities of the stairs and landings while adhering to all applicable codes and regulations.

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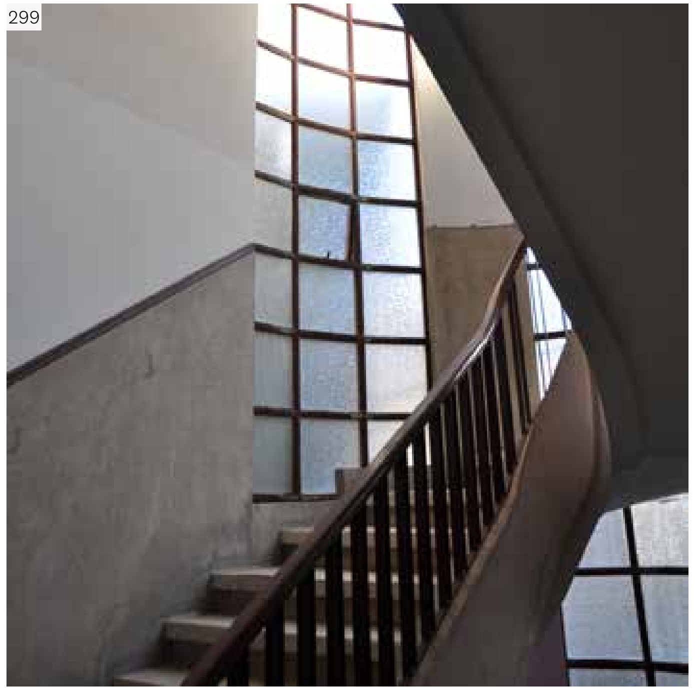

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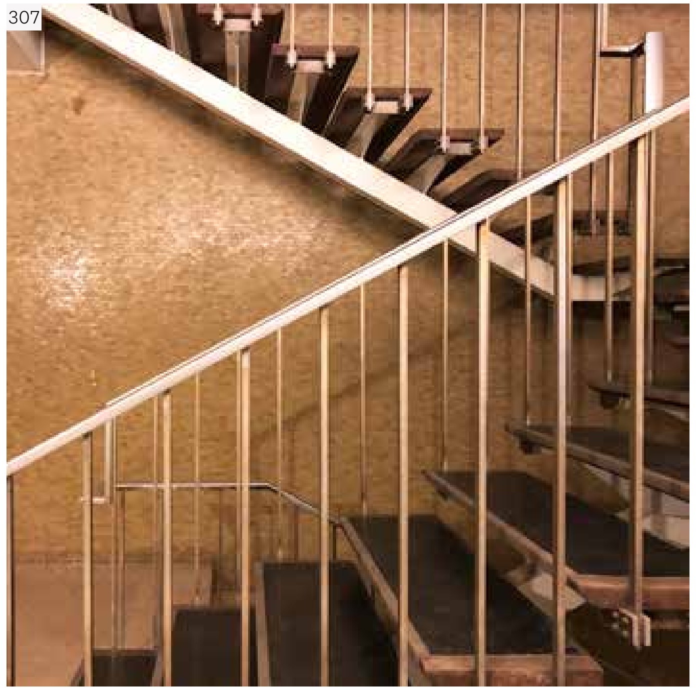

Landscaping

Gardens are an important part of residential architecture, particularly in a city like Beirut, where many preserved houses from the early twentieth century are still surrounded by a garden with fruit trees, a water basin or well, and other features. The suburban villa's garden was a complement to the house and an extension of the living space. Many architects and engineers integrated landscaping features into common spaces at ground level in the 1950s and 1960s, in keeping with modernist ideas of improving the relationship with nature and promoting pedestrian circulation. Because they serve as a transition between public and private spaces, these landscaped areas play an important role. They are frequently combined with the concept of the *Pilotis,* emphasizing spatial fluidity and transparency and contributing to a greener environment, particularly in urban settings.

Hard Landscaping

Planters, pavements, ponds, and other elements were built with natural materials such as limestone, basalt, and marble (310). It is recommended that the same or an equivalent material be used during restoration in terms of performance and specifications.

308

Soft Landscaping

Consultation with a landscape architect or botanist is recommended in order to achieve the appropriate plant selection and provide the required depth of earth for each plant.

309

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The evolution of the modern-day elevator has gone through several stages from its earliest form as a 'hoist' powered by animals or humans to the electrically powered rapid lift of today.

During the first century A.D., gladiators and animals in Rome were lifted onto the Colosseum's arena in a wooden cage through a system of ropes, pulleys, and counterweights that were manually operated by less than a dozen men. Centuries later in 1743, King Louis XV ordered the construction of a manually operated apparatus that would transport him to his mistress's quarters hidden from the meddlesome eyes of his court. The "Flying Chair," as it would be known, was successfully run by means of ropes and counterweights. Not long after, the introduction of the steam engine by James Watt during the industrial revolution of the early 1800s paved the way for the rapid evolution of lifting systems. Elevators became larger and more powerful to accommodate lifting cargo and people in and out of mines and factories. The lifts were also used during the construction boom of that period to lift all kinds of heavy building materials.

It is interesting to note that architecture played a significant role in the advancement of elevators. Architects Burton and Homer designed and built what was called an "ascending room" in 1823 to lift tourists onto London's rooftops for panoramic views of the city. Almost a decade later in 1835, English architects Frost and Stutt built the "Teagle", a counter-weighted lift driven by steam and a conveyer belt. It wasn't until 1846 that a hydraulic crane was introduced to the lifts, thus replacing its steam-powered predecessor.

In 1853, during the Crystal Palace Exhibition in London, an American inventor named Elisha Otis presented an innovation that would shape the future of conveyor devices. Driven by the need to safely products in his bedpost factory, Otis created a safety brake system that prevented the lift's cage from collapsing onto the ground in case any of its supporting cables broke (311). Following this invention, the elevator was labelled a safe transportation device, and in twenty years' time, more than 2,000 elevators were installed in buildings and department stores across the world. Another significant breakthrough in the evolution of the elevator took place in 1880, when Wernor Von Siemens built the first electrically powered elevator— a faster and much safer module than its predecessors.

311

Elisha Otis demo of his free-fall prevention mechanism, Crystal Palace, 1854.

Elevator companies in Lebanon

After elevators became prevalent across the United States and Europe in the mid-1940s, elevator manufacturers began to establish roots in the Middle East. In Lebanon, Otis, Schindler, and Rayes & Thewert were the leading companies that introduced modern elevators to the country. In 1946, Otis undertook a joint venture with Ibrahim Beik Sursock, and the company went on to install elevators in several key projects across Lebanon. It wasn't until the early 1970s that Otis established their official branch in Beirut. Another major elevator company to enter the Lebanese marketplace was Schindler Elevators. Established by Robert Schindler and Edward Villiger in 1874, Switzerland, the company started a joint venture with Mr. Pierre Michaca in 1971 after having installed quite a few of its elevators in Beirut's modern buildings. However, in 1978, during the Lebanese civil war, the company handed over its projects to a local elevator company that went by the name *Ascenseur de Liban*, only to officially re-establish itself back in Lebanon in 1999.

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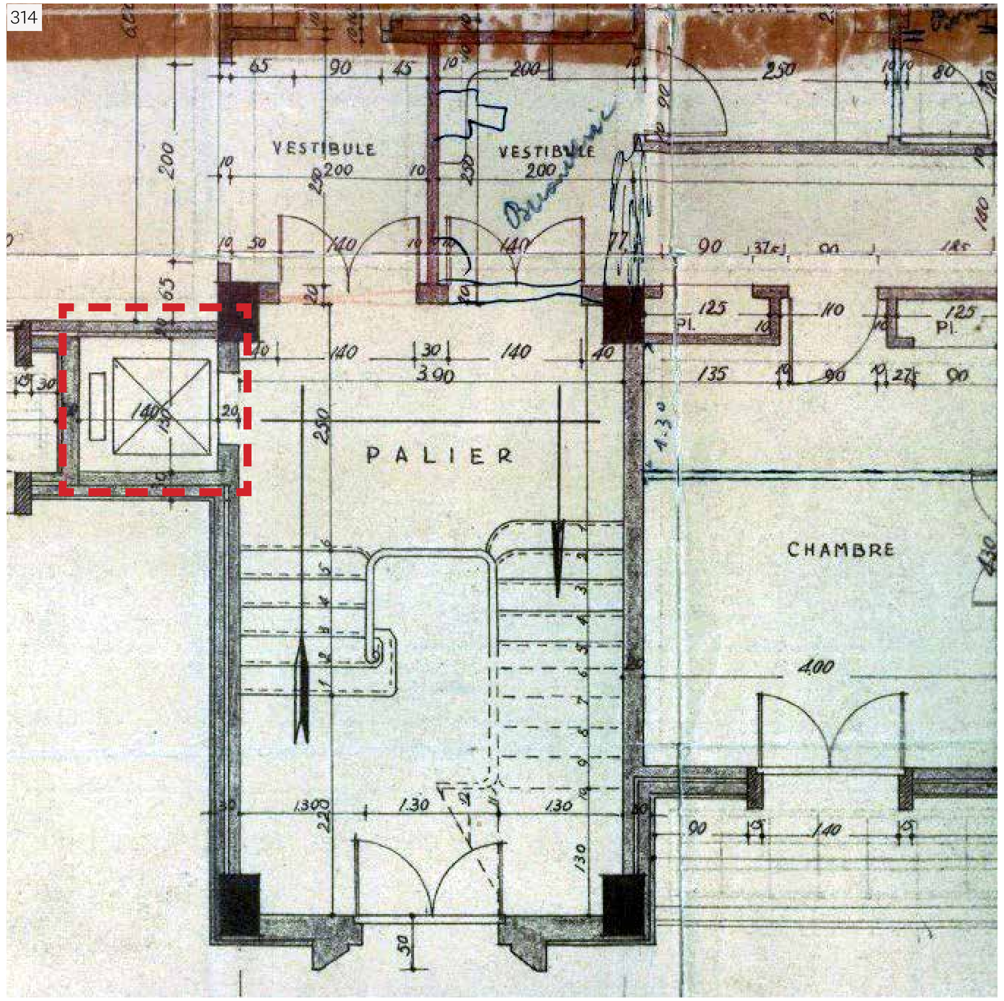

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Early elevators in Beirut

Mr. Rayes, of Rayes and Thewet Elevators, kept a memoir that was passed on to his daughter Mrs. Tania Rayes Ingea. The memoir mentions that the Sursock Building, designed by architect Bahjat Abdelnour, was one of the first commercial buildings in Beirut to have installed an elevator in 1934. Since Schindler's elevator company had established its branch in Syria by 1934, it is very likely that the Sursock building elevator was installed by the latter. However, after the joint venture between Ibrahim Beik Sursock and Otis was established in 1946, the building's elevator was replaced by Otis, as per the company's vice president (2011) Mr. Fouad Momneh. Unfortunately, it was very difficult to locate the buildings that had installed the earliest elevators in the city since most of them had either been demolished or have since updated their elevators.

A short list of buildings that had installed some of the earliest elevators in Beirut was compiled through interviews conducted with Mr. Elie Bsaibes, general manager of Schindler Lebanon (2011), and Mr. Fouad Momneh of Otis. One of these buildings was the Kantari Presidential Palace during President Bechara El Khoury's mandate. The elevator was installed with its ornamented wooden cage by Otis in the late 1940s and was part of the late president's endeavors to modernize the city.

By the early 1950s, elevators had already become widely spread in the city. A remnant of that era remains in the Charles Catafago Building near Furn el Chebbak. Designed by architect Antoine Tabet in 1951, the timeless structure boasts its original Schindler elevator. Tucked into the side of the building's subtle and somber entrance, the elevator often passes unseen at first glance (312, 313). For a first-time visitor, its door can easily be mistaken for that of an apartment. The building's blueprint, retrieved from the archive of its civil engineer, Mr. Georges Najjar, illustrates how the elevator space was discretely integrated into the building's overall design (314). This was a rather unusual choice by the architect and the client at that time, as having an elevator installed in a building was considered prestigious and exhibition-worthy.

On the other hand, the Njeim Building, which was built by architect Ferdinand Dagher in Achrafieh around the same year as the Catafago building, showcases its elevator quite differently. At the center of its spacious and elegant entrance stands the centerpiece elevator with its lavishly decorated ironwork. The elevator in this building seems to be celebrated more as an art piece than as a means of transportation (315, 316).

In 1952, politician and Prime Minister Saeb Beik Salam decided to install an elevator in his Msaytbeh home. He asked his nephew, architect Assem Salam, to integrate this new addition to the 200-year-old house. Featuring a unique double-entrance design, the new Schindler elevator was well incorporated into the house without the need of a built extension (317, 318).

Two years later, Schindler equipped Al Farra Building on Bliss Street with a double-door elevator. The mixed-use building has a reputation for its luxurious apartments and once housed the Australian Embassy. Similarly, the Majdalani and Halawani Building built in 1956 by architect Nadim Majdalani near Raouche was also equipped with a Shindler elevator that is still operated with its original motor and technical equipment today.

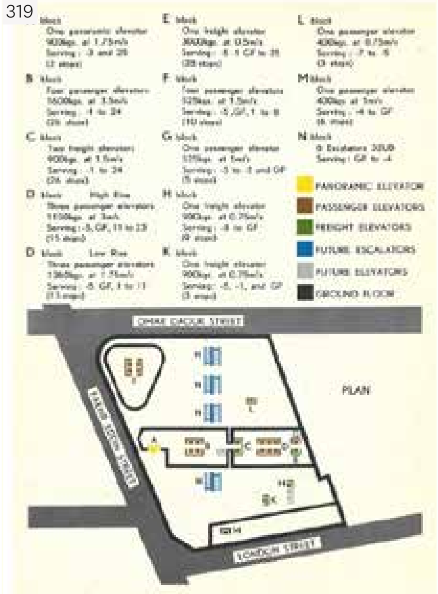
317

318

Elevators of the 1960's and 1970's

With the rapid development of the next two decades, elevators continued to spread and make appearances in various centers across the capital. In 1969, Schindler installed its Supermatic elevator in the Gefinor Complex designed by architect Victor Gruen. This elevator had a programmed control system tailored for high-rise structures. A couple of years later in 1971, Otis was commissioned to install 34 units of elevators and escalators in one of the city's most prominent projects, the Saint Charles City Center (319, 320). The sizeable, mixed-use complex was designed by French architect André Wogenscky in collaboration with Lebanese architect Maurice Hindié and featured the Holiday Inn Hotel on its premises (321). In 1974, Otis went on to install more advanced elevators and escalators in the Hilton Hotel in Downtown Beirut. However, briefly after its inauguration, the Lebanese civil war broke out, and all the elevator equipment was either damaged or stolen for parts.

319



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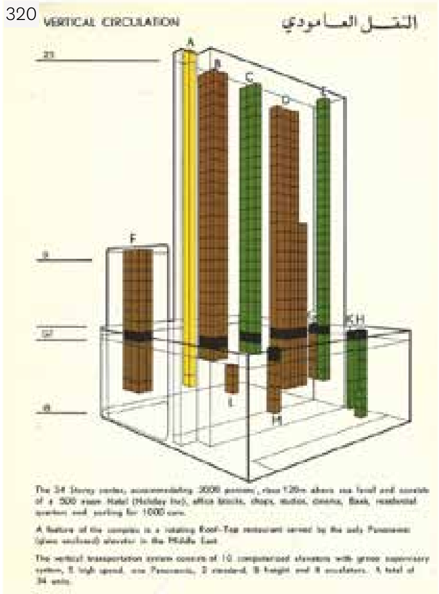


321

Characteristics of the Elevator Doors and Interior

In 1887, American inventor Alexander Miles received a patent for his automatic closing mechanism of the elevator shaft door. In 1944, another American inventor, Joseph Giovanni, received a patent for a safety bumper that prevents the elevator door from closing off on a passenger. Most of the elevators installed in Beirut during the 1940s and 1950s had two sets of either manually or automatically operated doors — one for the shaft and the other for the cab. The shaft door was hinged while that of the cab was often a sliding scissor gate. For safety reasons, the elevator would not function while the gate is open. Another failsafe would be the automatic closure of the gate once a floor button is pressed. Some elevators only had a shaft door that was composed of either a single panel that opens laterally or double panels that meet at the middle.

Other key features of the early elevators installed in Beirut included elaborate interior accessories like fold down seats for passengers' comfort, as well as bronze cigarette holders and ashtrays to accommodate smokers on their ride (323, 324). As for the metal cage of the elevator, it was either made of a simple criss-cross pattern or of a more complex pattern and decoration in wrought iron (322).

322

323

324

Advertisement

With only a few elevator companies operating in Lebanon during the 1940s and 50s, there was little need for advertising campaigns showcasing their products. Instead, these companies heavily relied on reputation and word-of-mouth to increase sales (325, 326). In the 1960s, however, technological breakthroughs in the elevator industry prompted competitive branding and drove companies into producing brochures and pamphlets illustrating new products and highlighting their qualities. A clear example of this can be seen in Otis' catalogue. The publication illustrates the number and placement of elevators and escalators Otis had installed in the Saint Charles Building in Ain el Mraisseh, as well as the first ever panoramic elevator installed in the entire Middle East (327, 328).

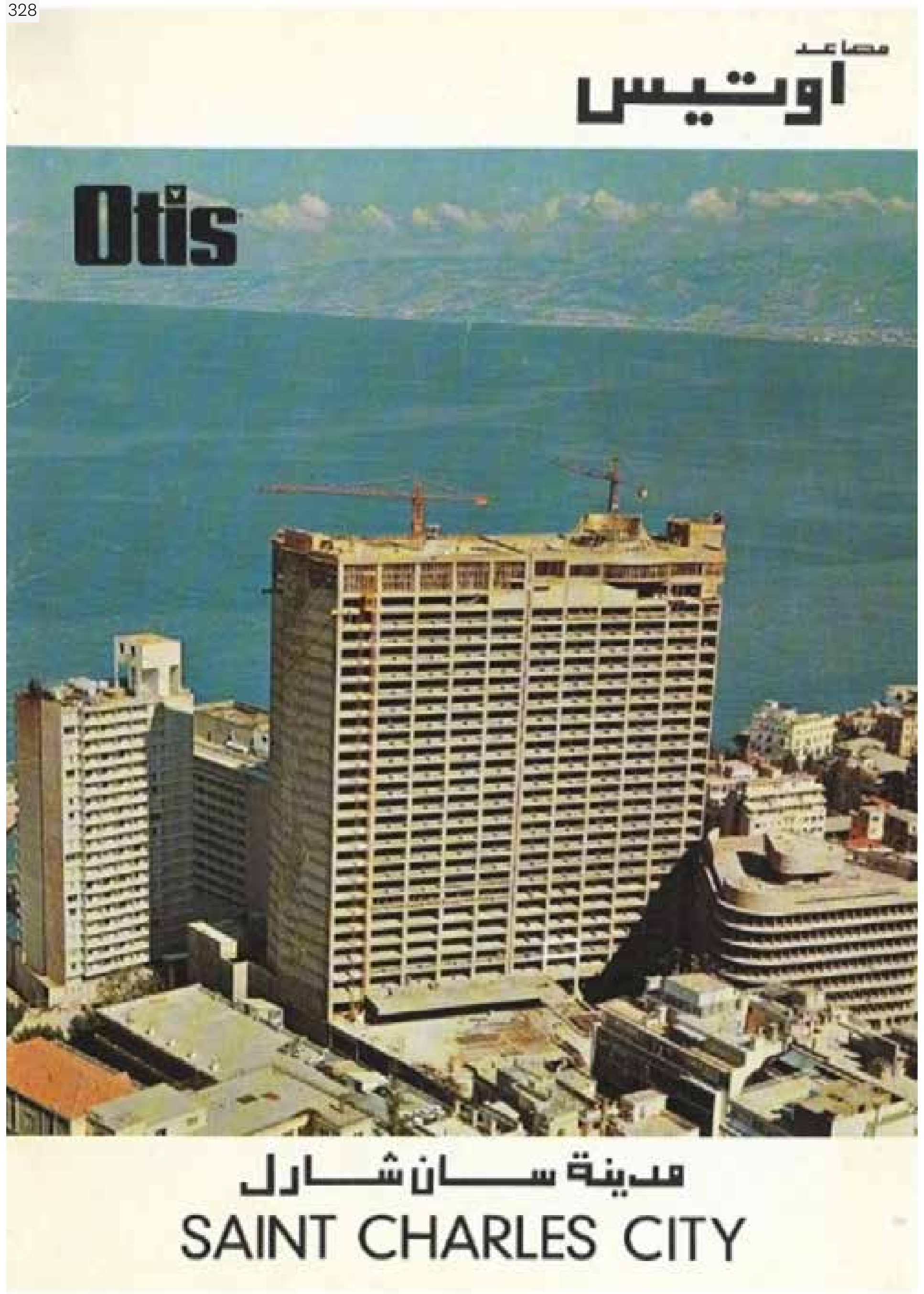
325

326

327

مصعد بانورامي
الوحيد من نوعه
في الشرق الاوسط
THE ONLY PANORAMIC
(GLASS ENCLOSED)
ELEVATOR IN THE
MIDDLE EAST
OTIS ELEVATOR COMPANY S. A. L.
TELEPHONE : 274310/14
شركة مصاعد اوتيس ش.م.ل.
هاتف : ٢٧٤٣١٠/١٤

328



مصاعد
اوتيس
Otis
مدينة سان شارل
SAINT CHARLES CITY

329


After acquiring a patent for his "moving stairs" in 1892, Jesse Reno created a new ride at Coney Island that was inspired by this concept. The term "escalator" was later coined by the inventor Charles Seeberger in 1897 after improving Reno's initial design. A collaboration between Charles Seeberger and Otis Elevators Company in 1899 resulted in the production of the first commercial escalator. The creation won first prize at the Paris 1900 *Exposition Universelle*, and henceforth, escalators became as important in hotels and department stores as elevators were in residential buildings.

According to Mr. Rayes's writing, the first escalator in Lebanon was built in the late 1960s at the Grand Magasins Byblos that was designed by architects Pierre Khoury and Henri Edde. As for Otis, its first escalator was installed in 1960 in Beirut's Intercontinental Phoenicia Hotel, designed by architect Edward Durell Stone in collaboration with architect Joseph Salerno and Lebanese architects Ferdinand Dagher and Rodolphe Elias. Another significant commercial building of the late 50s that was equipped with a Schindler escalator was the Starco Center designed by Swiss architect George Addord of Addord et Julliard in the capital's central district.

In 1967, Spinneys inaugurated its first department store in Beirut. That structure was designed by Polish architect Karol Schayer in partnership with Lebanese architect Nadim Majdalani and featured a Schindler escalator installed to facilitate customers' circulation between its floors. The remains of this escalator are still present on the premises of the abandoned building (329, 330, 331).

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331


Conclusion

It is evident that elevators and escalators had a great impact on the progression of architecture worldwide. This invention facilitated the spread of high-rise buildings, forever altering the skylines of our cities. The introduction of elevators in Beirut in the mid-1930s was primarily reserved for the wealthy and powerful, as it represented modernism, advancement, and prestige. Elevators later became an essential functional component of modern buildings, and architects handled their incorporation accordingly; in some buildings, they were highly decorated and celebrated as centerpieces of the overall building design, while in others, they were more discrete and subtly integrated. Eventually, elevators and escalators pervaded Lebanon's service industry in the 1960s, becoming staples of hotels, apartment buildings, and department stores throughout the capital during what was known as Beirut's golden age.

332


ACCESSIBILITY

Claudine Abdelmassih and Georges Xanthopoulos

Claudine Abdelmassih

The concept of disability has evolved significantly over the last few decades, even to the point of being redefined:

"Constitutes a disability, within the meaning of this law, any limitation of activity or restriction of participation in society, suffered by a person who has substantial, lasting or definitive alteration of one or more functions (physical, sensory, mental, cognitive or psychic, a multiple disability or a disabling health problem)" [1]

“Disability is not just a health condition. It is a complex phenomenon that arises from the interaction between the bodily characteristics of a person and the characteristics of the society in which they live. To overcome the difficulties that people with disabilities face, interventions to remove environmental and social barriers are needed” [2]

The Lebanese Ministry of Social Affairs estimates the proportion of disabled people in Lebanon at 4% (approximate figure), but this does not include people with temporary disabilities (accidents, illness) or the elderly who have lost their autonomy. These categories increase the number of people who could benefit from improved accessibility and living conditions as a result of an inclusive approachto mid-century residential building renovations. As a result, anyone would be able to access their home and perform daily tasks independently.

In light of the evolution of both social and technological standards, the preservation of heritage buildings is confronted with normative considerations, particularly in terms of accessibility, a topic that has long been neglected by Lebanon’s built sector but is becoming increasingly important.

Buildings in Beirut dating from the French Mandate and up to the 1960s include a variety of typologies that show the evolution of lifestyles as well as construction techniques. Each typology, from the detached house to the apartment building, has spatial and technical characteristics that should be exploited in order to conform to accessibility standards. This chapter provides, in the form of a checklist, some simple solutions to consider when renovating any residential building to make it more accessible. These interventions should enable anyone with a physical, sensory, cognitive, or psychological disability to independently travel the distance from the building entrance to their accommodation and to perform daily tasks.

The accessibility work primarily addresses the following issues:

Access into the building:

To ensure better autonomy for people with disabilities, it is important that their relationship to their direct environment (walking distance) and more distant (car) are optimized.

[1] *Law dating from February 11, 2005, Article 114, France*
[2] *World Health Organisation (WHO)*

In Beirut, several old buildings suffer from a lack of parking space. In order to ensure proper service, it is important to provide a reserved parking space directly near the main entrance, or even on the roadway, respecting the required dimensions and marking the space with adequate signage. Pedestrians should also circulate independently, by foot, or in a wheelchair. To do so, any change in level should be accompanied by a device facilitating the transition from one level to another (boat, ramp, guardrail, etc.).

Vertical circulation:

The elevator represents the best solution in terms of vertical movement. Sometimes it turns out to be unsuitable, and choices must then be made to replace it or amend it.

In the absence of an elevator, a careful inspection of the stairwell and common areas allows to choose the optimal solution:

- Fit out a cabin accessible via certain vertical shafts or in the voids left by the stairwell.
- In the case of individual houses, an exterior elevator is possible with some works.
- If the installation of a lift proves impossible, the stairs can be equipped with a suitable layout such as a continuous handrail or a vertical platform, if the space allows it.

Horizontal circulation:

To ensure proper horizontal circulation, it is important to reduce, or even eliminate, when possible, all the ground asperities, in particular thresholds between rooms, which could hinder the movement of the user.

Sufficient passage width in the corridors, at the level of the doors and in the rooms, also needs to be ensured.

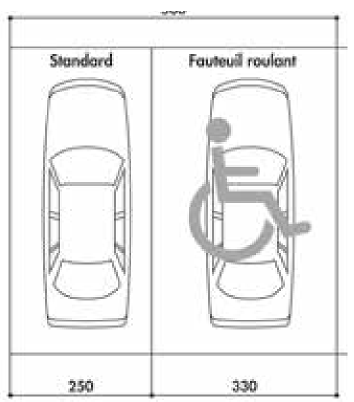
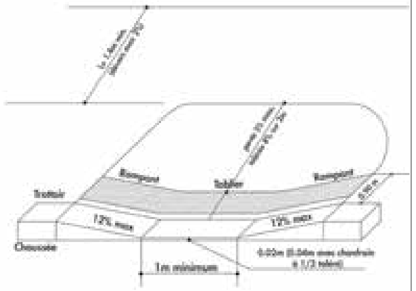
Light switches should be located at the entrance of each room. Any control device (switches, window and door handles, etc.) should be at a height of 90 to 130 cm. The height of electrical sockets must not exceed 130 cm.

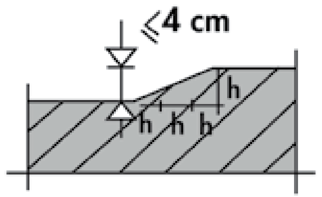
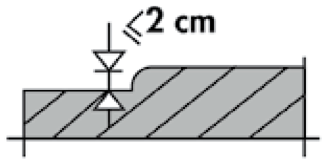
The dimensions of the house functions are as follows:

Each room requires resizing in clearances and heights. The checklist cites the most essential ones.

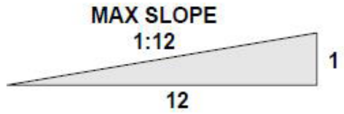
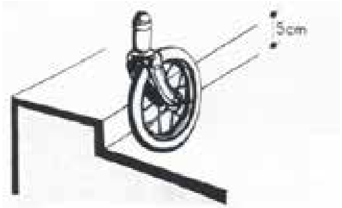
Remote commands:

Technological advances related to home automation now allow remote access to home controls. They offer users with disabilities an optimized environment ensuring great autonomy. Unfortunately, these facilities are expensive. To avoid unnecessary costs, it is necessary to select controls wisely based on the needs of each user and the type of disability.

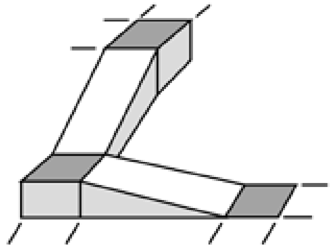
Exterior amenities		
		Possible Action
Is there a reserved parking spot available?	Size of a parking space 	Create a reserved parking space
Is circulation in public spaces facilitated around the building?	Example of a boat at curb level 	Create one or more boats on the sidewalk

Changes in Surface Level		
		Possible Action
Are all ground and floor surfaces free of abrupt changes (small rises, dips, holes, etc.) in surface level? 2 cm changes with rounded edges and 4 cm rises with a slope of 1:3 are acceptable.		Treat abrupt changes as per the following: - 2 cm changes with rounded edges - 2 to 4 cm rise with a slope of 1:3 - Otherwise, provide a slope.
Are ramps provided for vertical variations greater than 2 cm in height?		Install ramps with adequate slope as indicated in the slope section.

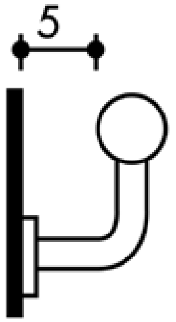
Ramp Slope

		Possible Action
Does the slope adhere to the following requirements: 1:12 on a maximum distance of 2 m 1:10 on a maximum distance of 4 m 1:8 on a maximum distance of 6 m 1:6 on a maximum distance of 10 m 1:5 on a maximum distance of 15 m 1:4 maximum with a landing every 20 meters?		- Lengthen ramp to decrease slope. - Relocate ramp. - If the available space is limited, reconfigure ramp to include switchbacks.
Is a 5 cm side-edge for the ramp available to prevent wheels from sliding off the pass?		Provide an edge for the ramp.

Landings

		Possible Action
Do ramps and curb ramps have a level landing of 140 cm in length at the top and bottom or 200 x 250 cm if in front of a door?		Remodel or relocate ramp.
Do ramps have a 150 x 150 cm level landing at locations where ramps change direction (switchback) or at intervals of 60 cm vertical rise?		

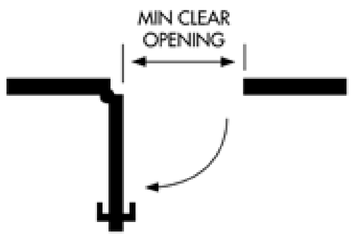
Handrail Location

		Possible Action
Is the top surface of all handrails mounted between 80 cm and 100 cm above ramp surface?		- Adjust height of railing if not between 80 cm and 100 cm. - Secure handrails in fixtures.
If the handrail is wall mounted, is the clear space between the handrail and the wall exactly 5 cm?		
Is the diameter of the handrail 3 to 4 cm, or does the shape provide an equivalent gripping surface?		

Entrances, Corridors and Stairs

Accessibility is often used to focus on people with disabilities or special needs and their right of access to entities, often through the use of assistive technology. Main entrances should be adapted to eliminate steps, or they should include a ramp as an integrated feature of the entrance area.

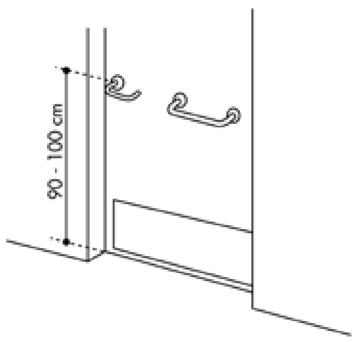
Doorway Width

		Possible Action
Does the primary accessible entrance have a minimum clear opening (free of protrusions and obstructions) of 90 cm?		Install offset (swing-clear) hinges.
Is there a minimum of 140 x 120 cm of level space before the door and 150 x 200 cm of level space after the door (in the direction of opening) centered on the front of the accessible entrance?		Widen the doorway.

Door Opening Force

	Possible Action
Can doors at accessible exterior entrances be opened with a force of 5 kg or less?	- Adjust or replace closers. - Install lighter doors. - Install power-assisted door openers.
Can interior doors be opened with 5 kg, or less, of force? Note: Fire doors require a minimum of 7 kg of force to open.	

Door Hardware

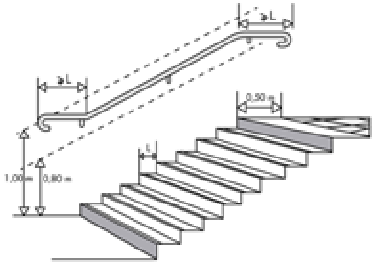
		Possible Action
Are handles, pulls, latches, locks, and other operating devices on accessible doors easily grasped with one hand, and require no tight grasping, pinching, or twisting of the wrist to operate?		Install handles, pulls, latches, locks, and other operating devices on accessible doors.
Is hardware required for an accessible door passage that is mounted no higher than 100 cm above the finished floor surface?		- Lower handles. - Add lever extensions. - Install power-assisted openers. - Replace knobs or latches with lever or loop handles.

Doors in Series

	Possible Action
Does approximately 140 cm, plus the width of in-swinging door(s), exist between two doors in a series to allow backing and turning space for a wheelchair or other mobility aid to clear the in-swinging door?	Replace the in-swinging door with an out-swinging door.

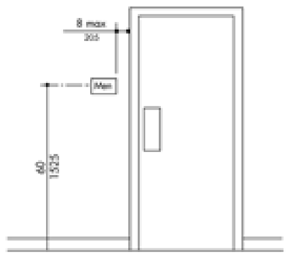
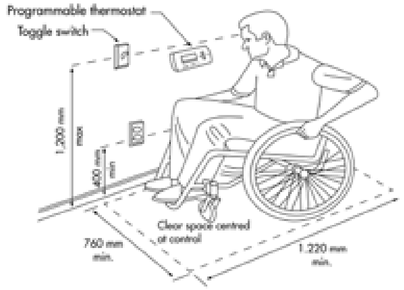
Stairs

		Possible Action
Is the tread surface non-slip?		Add non-slip surface to treads
Is there a 60 cm wide and 60 cm deep strip at the top and bottom of the stairs to indicate the presence of stairs?		Provide strips.
Are the stair rails continuous on both sides, with 30 cm extensions beyond the top and bottom stair?		Add or replace handrails.
Is the handrail easy to grasp?		Add or replace handrails
Is the riser height less than or equal to 16 cm, and the tread depth equal to or greater than 32 cm?		Provide alternative staircase or ramp.
Is there a landing of 140 x150 cm when the height of the stairs exceeds 250 cm?		Provide alternative staircase or ramp.
Is the stairwell at least 120 cm wide measured between the handrails?		Provide alternative staircase or ramp.



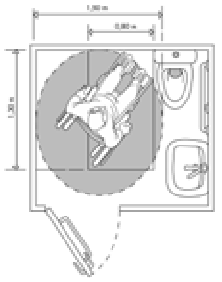
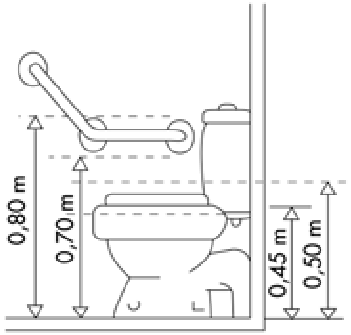
Interior Accessible Route

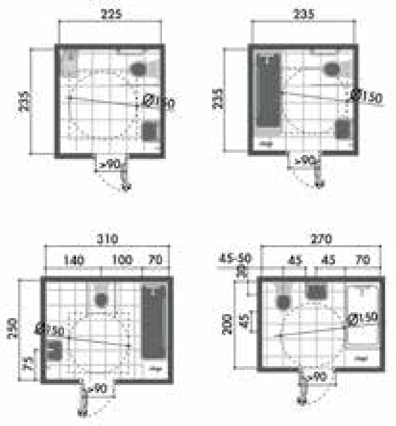
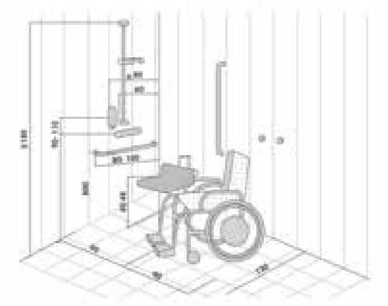
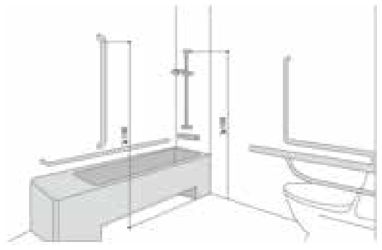
Accessible route denotes a continuous unobstructed path connecting accessible elements and spaces in a building or within a site that can be negotiated by a person with a severe disability using a wheelchair and that is also safe for and usable by people with other disabilities. Interior accessible routes may include corridors, floors, ramps, elevators, and lifts.

		Possible Action
Do signs indicating permanent rooms and spaces, such as restrooms, meeting rooms, and offices, meet the requirements for accessible signage?		Provide signage that has Braille or raised letters and numbers that meets finish and contrast standards. Ensure that signage is installed at the proper height and location: 1.5 m above the floor, on the latch side of the door.
Are all controls that are available for use by the public (including electrical, mechanical, window, cabinet and self-service controls) located at an accessible height? It should be noted that the maximum height for a side reach is 1.2 m. The shortest reachable height is 40 cm. Can they be operated with one hand and do not require tight grasping, pinching or twisting of the wrist?		- Relocate controls. - Replace controls

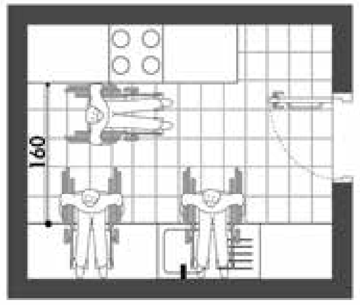
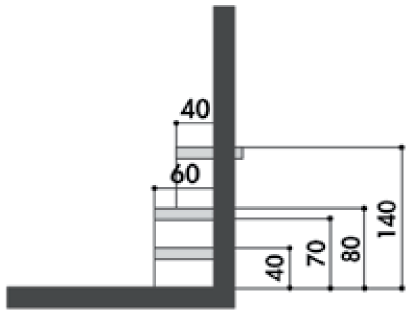
Bathrooms - Sinks

There must be enough maneuvering space in bathrooms for a wheelchair user to enter, close the door, use the fixtures, and exit.

		Possible Action
Are public toilets available, i.e., at least 1 per floor for each gender?		Build toilets accessible to all kind of public
Is the floor of the toilets slip-resistant and easily cleanable?		Provide slip-resistant and easily cleanable floors.
Is there a 1.5 m diameter for the wheelchair and a 0.8 m x 1.3 m space next to the toilet?		Construct new toilets.
Is the sink less than 0.85 m from the floor, and the water closet at 0.45 m?		Construct new toilets.
Is there a rail near the toilet that is between 70 and 90 cm high?		Add rail.
Is the highest operable part of the phone no higher than 1.2 m?		Lower telephone.

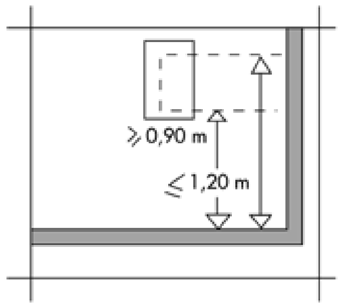
		Possible Action
	Size of a bathroom 	Resize the bathroom.
		Add grab bars

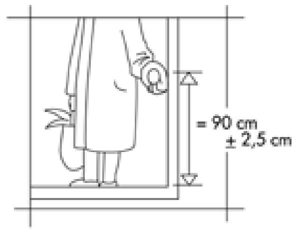
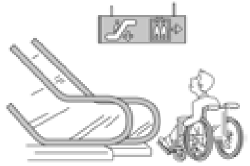
Kitchens

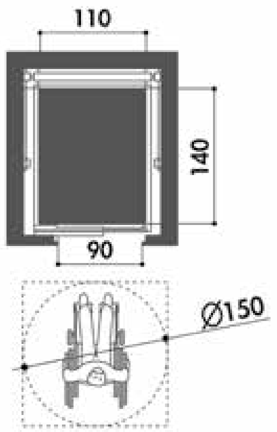
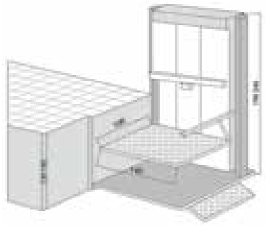
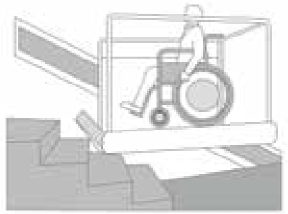
		Possible Action
	Kitchen clearance 	Ensure smooth movement from one function to another
	Optimum worktop and cupboard height 	Adjust the heights of the worktop and cupboards

Elevators and escalators

Elevators are an important part of disabled access to the entire building.

		Possible Action
Are there visible and verbal or audible door opening/closing and floor indicators (one tone=high, two tones=low)?		Install visible and verbal and audible signs.
Is the height of the call buttons in the hallway greater than 1.2m? Are they raised or flush?		Install lower call buttons. Provide a permanently attached extension pole.
Are the controls inside the cabin embossed and in Braille?		Install embossed letters and braille next to buttons.
Is there a sign identifying each floor on the upright in raised letters and braille?		To identify floor numbers, install touch panels 1.5 m above the ground.
Is the emergency intercom functional in the absence of voice communication?		Replace the communication system.
Is a symbol and embossed lettering used to identify the communication system?		Add symbol and embossed lettering.

		Possible Action
Can the lift be used without assistance?		At each stop level, display clear instructions for using the elevator.
Is there at least 1.5m by 1.5m clearance for a wheelchair user to reach the controls and use the lift?		Rearrange furniture and equipment to make more room.
Are the controls between 0.9 and 1.2 m high?		Move controls.
Is there a 90 cm high handrail inside the cabin?		Install the handrail.
Is the door width of lifts (or at least one lift) at least 80 cm?		Provide an elevator with these dimensions.
Is the cabin's interior dimension less than 110cm x 140cm?		Provide an elevator with these dimensions.
Is there a sign at the escalator entrance indicating the location of the nearest elevators?		Provide signage.

		Possible Action
	Design of an accessible elevator. 	Install an accessible elevator
	Example of vertical translator  	Install a vertical translator.

WHAT FUTURE FOR OUR HERITAGE

Yasmine Dagher, Fadlallah Dagher

THE BEIRUTI HERITAGE: HISTORY

Yasmine Dagher

It is said that Beirut was destroyed seven times. The explosions at Beirut's port on August 4, 2020, will have destroyed it once more.

In 551, an earthquake followed by a tidal wave reduced it to ruins. A small medieval city surrounded by walls, Beirut recovered during the Ottoman period, when the port was expanded beginning the 1830s. Beirut, revitalized, became the regional economic capital. Greater Beirut expanded rapidly between the 1860s and the 1940s, and it now extends beyond the municipal limits. The city we know, with its avenues and high-rises, is devoid of public spaces, green and pedestrian areas, a public transportation network, and parking lots. Its master plan, established in 1954, is still in use for a city that has changed 70 years later.

With the civil war (1975-1990) and fifty years of laissez-faire (1970-2020), Beirut’s identity has shifted. Its “rebuilt” Downtown is deserted. The city that was once known as the "Paris of the Middle East" is now known for its chaotic silhouette.

Urban Morphology

We observed in our first manual, “Houses of Beirut, 1860 – 1925” and in this second publication, “Architecture of Beirut, 1925-1970”, that Beirut’s Heritage encompasses various periods and scales of buildings: The Ottoman period (1860 -1920), the inter-war period (the French Mandate, 1920-1943), known as the hybrid transitional period, and the Modern period (1943-1970) (333).

The typology and footprint of the building differ depending on the construction period. Three scales can be distinguished:

- The individual structure: a single building, house or palace. The Beirut house is surrounded by a garden or orchard of fruity trees. These private or semi-private gardens preserve social practices: a household’s survival is dependent on the productivity of its garden.

- The cluster: Buildings and blocks that include semi-public and public spaces such as streets and cul-de-sacs, common orchards, and so on. The cluster is hybrid, consisting of buildings from one or more periods.

- The neighborhood: A larger, architecturally hybrid, ensemble whose unity is founded on social fabric.

It is critical to protect our heritage at the neighborhood level in order to preserve it. This could result in a reconsideration of Beirut's master plan and the preservation of the city's fabric.

Many public institutions (Ministry of Culture - Directorate General of Antiquities, Municipality, Directorate General of Urban Planning, etc.) are concerned with urban heritage preservation, but they are ineffective, and civil society is proactive in raising awareness: APSAD (Association for the Protection of Sites and Heritage Residences in Lebanon, founded in 1960 by Yvonne Lady Cochrane, Assem Salam, and Camille Aboussouan), the National Heritage Foundation (1996), and Save Beirut Heritage (2010) and others...

333

The Beirut Master Plan

The 1954 Master Plan places the greatest density on the old city, its historic center, and the pericentral regions (334). Due to the lack of heritage protection measures or regulations, property developers have purchased and demolished heritage buildings, which have been replaced by high-rise buildings that alter the neighborhood's silhouette. Since the 2000s, the local economy has been reliant on the city's real estate development, denying residents access to affordable housing, and contradicting the preservation of the urban fabric. We can cite several examples that took advantage of the Master Plan of 1954's regulations:

- Sama Beirut (2016): The tallest building in Beirut (195m), with 51 floors of offices, shops and residential apartments. The tower is built on land larger than 4,000 sqm (several plots were grouped together for the project's construction), allowing it to exceed the height limits (gabarit) set by the urban plan.

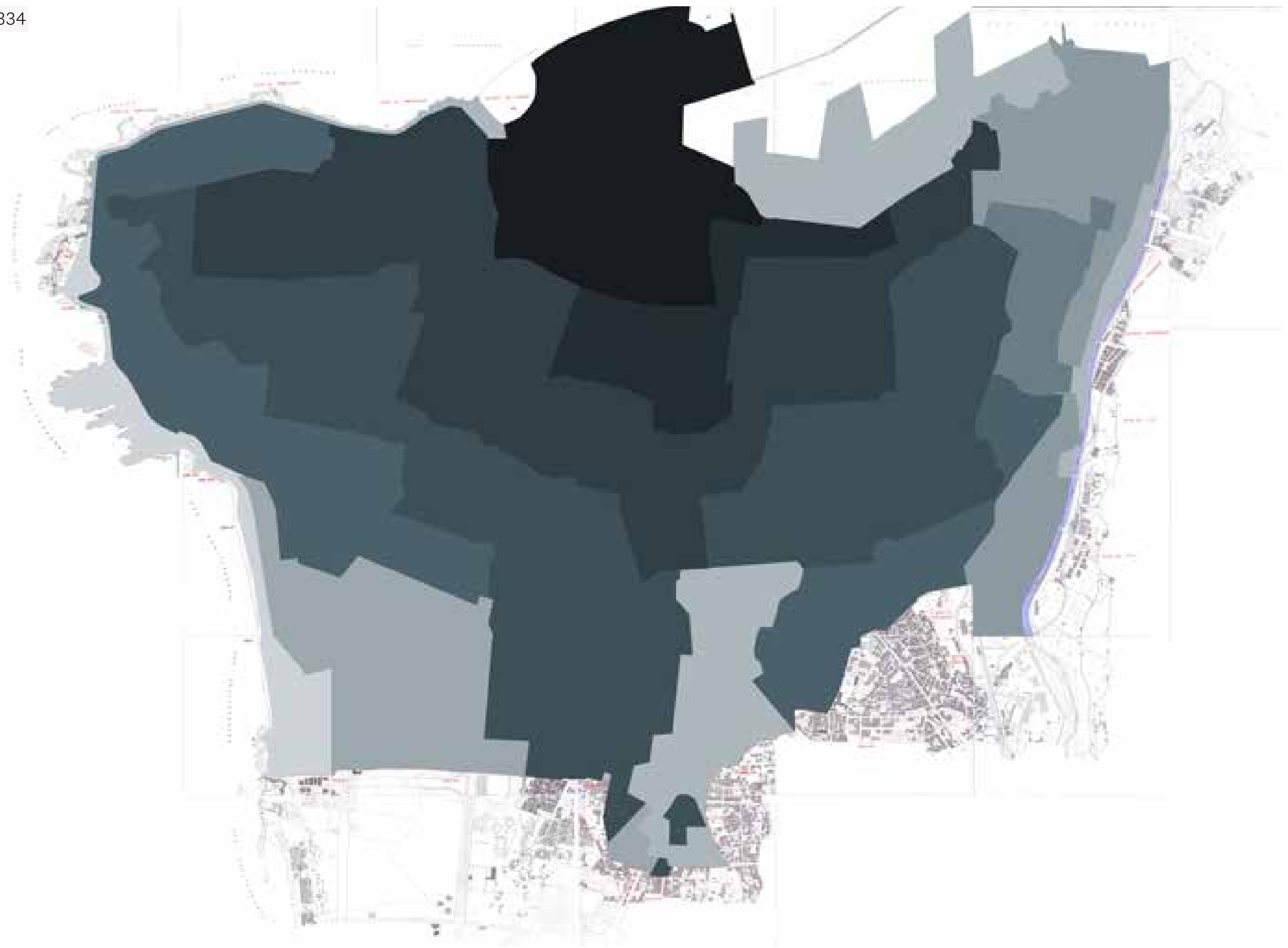
- The Ibrahim Sursock residences (2010): This 27-story tower was built in the garden of Villa Linda Sursock, one of the heritage houses on Sursock Street. The building's imposing footprint overlooks and crushes the house and the remaining portion of the garden. The construction of this complex, in 2005, was accompanied by restrictive measures put in place by the DGU, and a study of a large perimeter around the Sursock and Gemmayzeh neighborhoods. To date, the urban study is not established.

- Place Pasteur (2019): Located in the Medawar-Gemmayzeh district between Gouraud and Pasteur streets, this project took more than 15 years to reach completion due to the discovery of Roman era remains during excavation works. The demolition of the Ottoman-era "Sainte-Famille" school and its replacement by the "Place Pasteur" project impacted the urban cohesion of rue Gouraud, which is home to four medium-sized buildings (between 6 and 9 floors) and a 36-story tower.

- Les Dômes de Sursock (2013): A 125-meter tall residential tower with apartments ranging in size from 400 to 600 square meters, built on the site of the Nicolas Bustros palace and garden (Ottoman period).

In the absence of a master plan, real estate developers exploit all of the surfaces authorized by the regulations, contradicting the morphology of the neighborhood and the urban fabric. Archaeological remains are frequently unearthed and dismantled during construction. These remains are integrated into a project space that is supposed to be open to the public in order to "preserve and enhance them".

334



Built density decreases depending on the color opacity

Beirut zoning

Zone 1 · Zone 2 · Zone 3 · Zone 4 · Zone 5

Zone 6 · Zone 7 · Zone 8 · Zone 9 · Zone 10

The Vehicular Circulation

The 1954 Master Plan crisscrossed the city with avenues to manage the ever-increasing car traffic since the 1950s. In the 1960s and 1970s, the layout of these avenues caused significant damage to the urban fabric. Hundreds of buildings from the Ottoman and French Mandate periods were demolished (335). These wide avenues obstruct pedestrian traffic in the neighborhoods they pass through (336, 337).

- Charles Hélou Avenue (1958): built to connect Beirut with the northern coast (Jounieh, Tripoli, etc.). This avenue has since separated the Medawar district from the Bay of St. André (which became the third basin of Beirut's port), as well as Mar Mikhael from the Quarantine (this last district finding itself isolated and disconnected from the city). The Charles Hélou station (parking lot, bus and taxi stations) was built to accommodate the daily influx of workers from Beirut's northern suburbs. Despite its potential and the needs of local residents, this parking complex is currently underutilized.

- Avenues Bechara El-Khoury, Georges Haddad, Charles Malek and Fouad Chehab (the "Ring") intersect and divide the city: The Bechara El-Khoury Avenue divides Beirut into East and West districts and served as an important demarcation line during the civil war. The Charles Malek / Fouad Chehab Avenue separates the city's north and coastline from the hills of Ashrafieh, Bachoura, and Zokak el Blat. Similarly, the City Center is separated from the pericentral area by Avenue Georges Haddad and the "Ring" which will define the perimeter developed by SOLIDERE at the end of the civil war (Lebanese Society for the Development and Reconstruction of Downtown Beirut, founded in 1994) (338, 339).

335

336

Aerial view on the hill of Ashrafieh, before the construction of Sassine Square, 1943

337

Aerial view on the hill of Ashrafieh, during the construction of Sassine Square, 1972

338

Aerial view of the port and the city center of Beirut, 1926

339

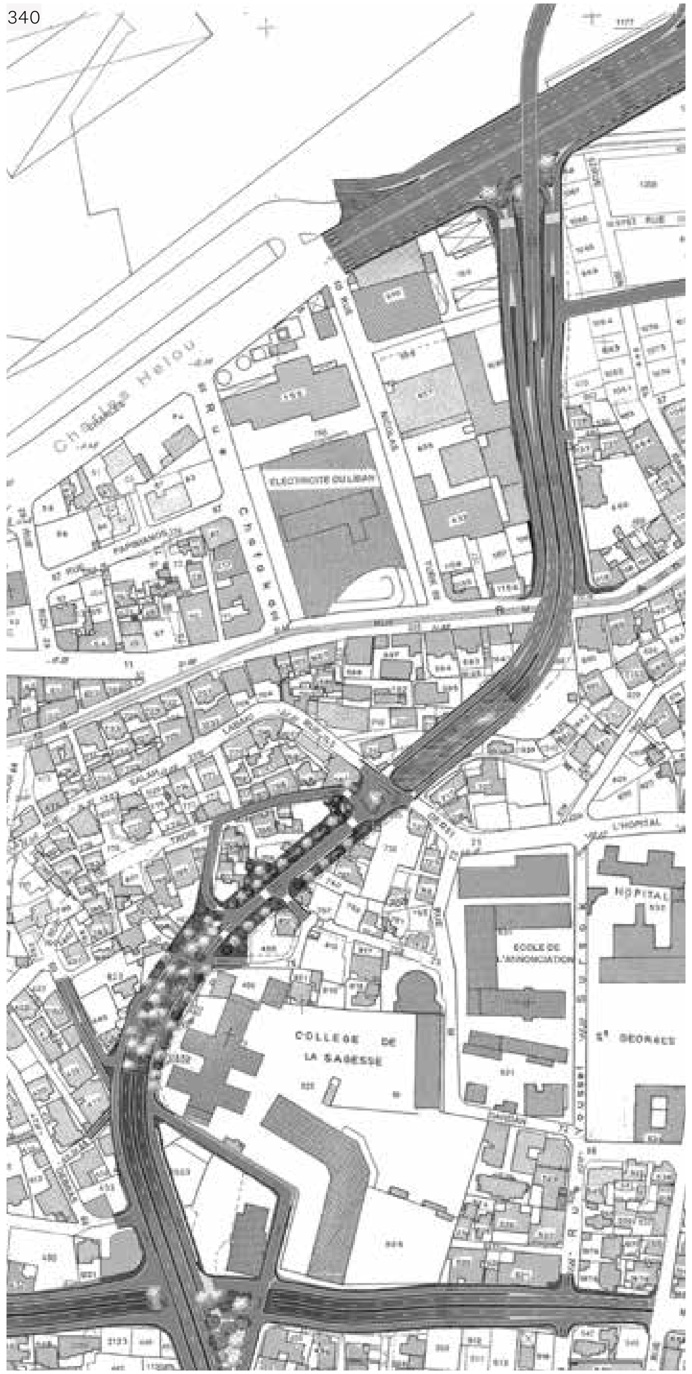
Aerial view of the port and the city center of Beirut, 2020

- Hekmeh-Turk Avenue (Fouad Boutros): one of two unfinished routes, along with the Petro Trad Avenue. The Fouad Boutros Avenue, an extension of Alfred Naccache Avenue, is intended to connect the Ashrafieh district to the Port and the Charles Helou Avenue. Its path threatens a neighborhood rich in traditional, transitional and modern heritage, and it crosses the region's last orchard. The avenue's construction would have an impact not only the built fabric, but also on the social fabric due to the increased real estate development and gentrification, as well as the elimination of the neighborhood's rare green spaces (340).

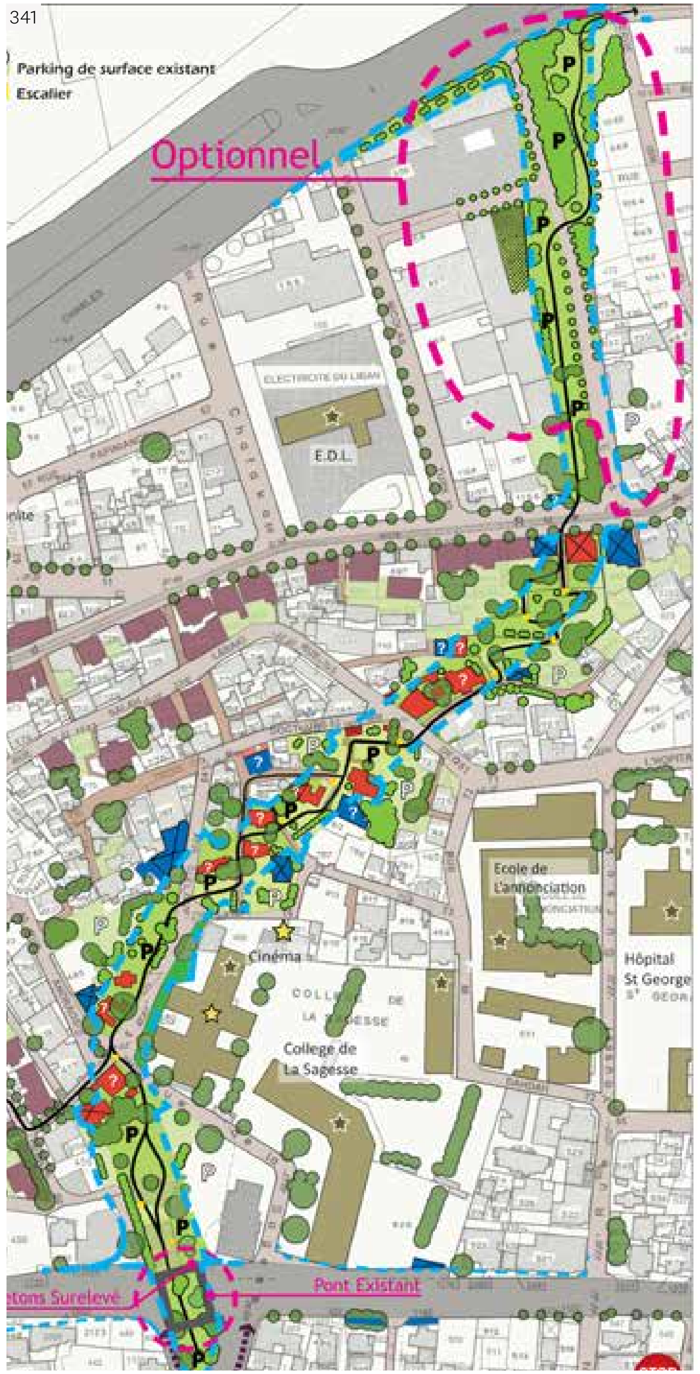
Many cities worldwide are currently remodeling avenues and urban highways built between the 1950s and 1970s in order to promote soft mobility and public transportation. A coalition of NGOs, urban planners, and architects proposed an alternative to the Fouad Boutros Avenue project in 2014, dubbed "Stop the Highway, Build the Fouad Boutros Park" (341). "The Fouad Boutros Park project illustrates a new vision of the city, offering citizens desirable spaces of recreation, an improvement of public space appropriation, of pedestrian and soft mobility, as well as a real enhancement of quality of life. The Fouad Boutros highway will be replaced by a long sloping park, descending like a stairway from the heights of Ashrafieh down to the neighborhoods of Mar Mikhayel, Gemmayzeh and Sursock, integrating in its path more than 20 historic buildings and thousands of square meters of gardens, that are already expropriated. It is an immense opportunity for Beirut, to finally gain a recreational green space, which will benefit from a very rich existing vegetation."[1]

[1] *The Civil Coalition Against the Highway Project "Hekmeh-Turk" Axis ("Fouad Boutros" Road) https://stopthehighway.wordpress.com/*

340



341



What legal framework is in place to safeguard cultural heritage?

The Law of Antiquities, promulgated in 1933, is the only document that governs the conservation of built and urban heritage in Lebanon. It protects buildings built before the year 1700 and defines the conditions of protection for more recent buildings in exchange for State compensation. Many efforts were made to update this law beginning in the 1990s, near the end of the war:

- 1992: Establishment of the Ministry of Culture

- 1995-1996: The Ministry of Culture begins an inventory of heritage buildings in Beirut's pericentric ring. APSAD has listed 1019 heritage buildings built between 1860 and 1943 (Lebanon's Independence) as a first phase (342). They are divided into three categories of importance based on their interest or condition. Minister Michel Eddé declares a moratorium on the demolition of listed historic structures. Following protests from landowners and real estate developers, the second phase (spanning the entire Beirut Municipality) has been halted.

- 1997: Saad Khaled, Director General of Urban Planning, recommends a conservation strategy based on the protection of urban groups (clusters) and iconic buildings, as well as green spaces. [2]

- 1998: At the request of the Government, the Council for Development and Reconstruction (CDR) and the Khatib & Alami agency reassesses the APSAD inventory: of the 1,019 buildings listed by APSAD, only 459 are retained according to criteria based on the architectural value of individual buildings, rather than an urban vision and coherent heritage ensembles (343).

- 2000: Minister Ghassan Salamé initiates consideration of a Heritage law, which his successor Tarek Mitri will table in Parliament without further action.

- 2010: Minister Salim Wardy requests from the municipality that any demolition request be submitted to Directorate General of Antiquities (DGA) for advice and validation. To evaluate applications, an advisory committee of specialists is formed.

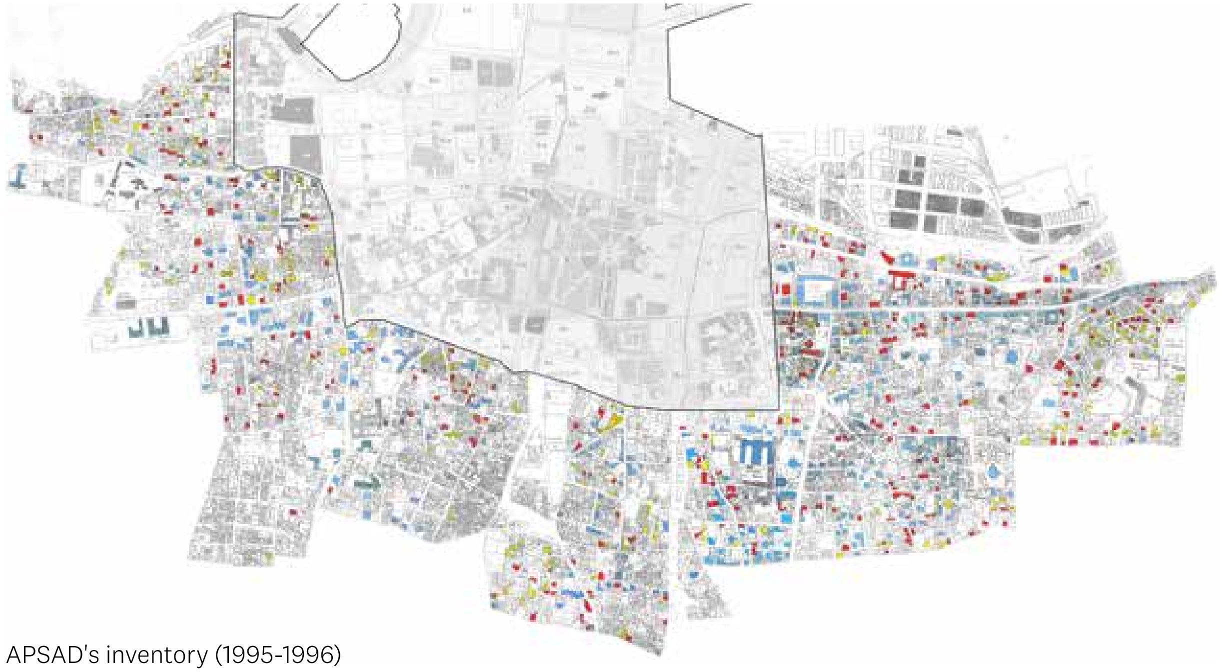
- 2014: The advisory committee, under the leadership of Minister Rony Araygi, identifies the areas to be protected for their heritage value and develops a Plan (the Beirut Heritage Map) which includes the modernist era (348).

- 2015-2016: The DGU and the Governor of Beirut refuse to support the proposals to investigate the protection zones. The heritage law is reviewed by a commission chaired by the Minister of Culture and is submitted to the Council of Ministers. The inventory of heritage buildings in Beirut is updated by the DGA.

- 2017: In October, the Council of Ministers sends the Heritage Law to Parliament. It has since been studied in committees, but no tangible results have been obtained to date.

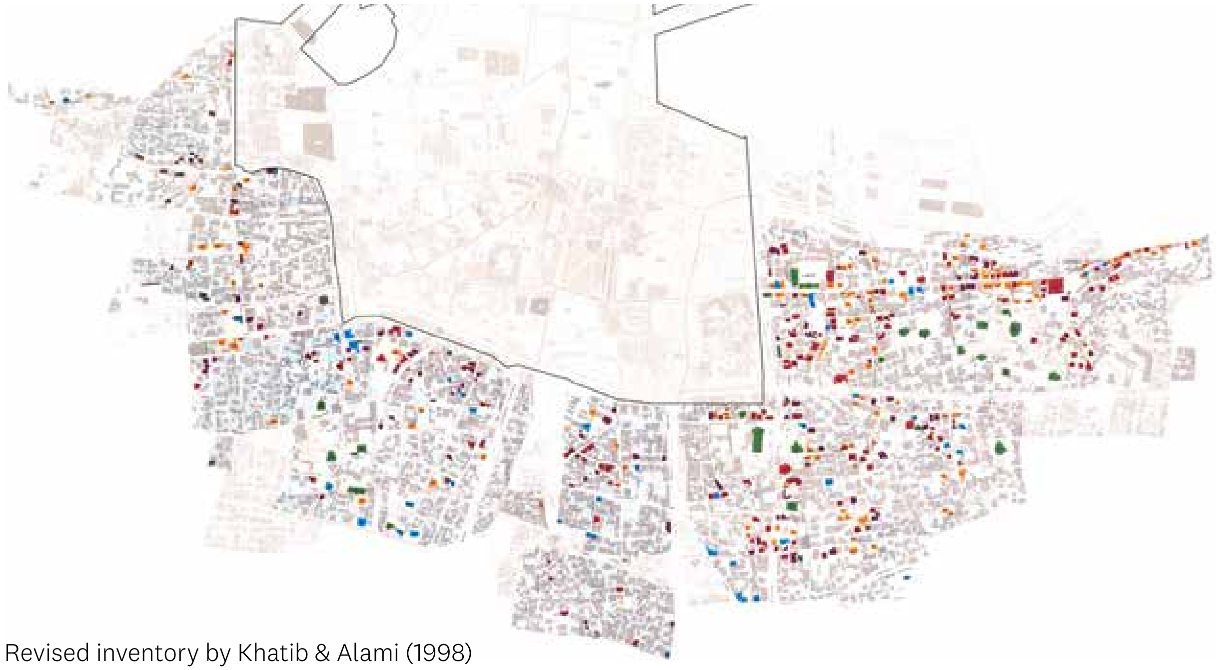
[2] *The summary plans for the urban conservation strategy were drawn up by a team of volunteer activists: Hana Alamuddin, Fadlallah Dagher, Habib Debs, Abdul-Halim Jabr and Wissam Jabr.*

342



APSAD's inventory (1995-1996)

343



Revised inventory by Khatib & Alami (1998)

The Heritage Law (2017)

Owners of heritage buildings are encouraged to sell or demolish their buildings for a variety of reasons, including:

- These buildings are inherited from generation to generation, multiplying the beneficiaries.

- The owners lack the resources to renovate and maintain their building, which is frequently occupied by old leases of negligible value (rental law continues to be heavily stacked against the owners).

- The collective memory of Lebanon's civil war and the subsequent events drives the owners to abandon their neighborhood, if not the country (the peri-central neighborhoods were seriously affected by the civil war).

- The high density and real estate pressure cause the building to be demolished in order to make a much more profitable investment in the short and medium terms (a Beiruti 2-storey house is replaced by a building with several apartments).

Owners will be able to benefit from a legal and financial tool that will promote the preservation of the urban fabric with the update of the law for the preservation of heritage. Because the State lacks the financial resources to compensate the owners for their loss of earnings, the law proposes a mechanism for transferring the operating coefficient: unbuilt areas of plots (defined by the master plan of 1954) could be sold to real estate developers and transferred to predefined areas suitable for receiving an addition (not exceeding 20% of the authorized built-up area). Many countries follow the Transfer of Development Rights (TDR) principle. To qualify for the TDR, the building must be registered with the Ministry of Culture and the DGA:

- Heritage building preservation: Unbuilt areas could be sold or kept by the owners. The residual or sold areas will be listed on the title deed.

- Development Rights Transfer: The owner of the listed building can transfer and sell some or all of the unbuilt potential. On the other hand, the buyer (and thus the receiving land) will be unable to acquire more than 20% of the plot's maximum built-up area.

- Subsidies and tax breaks will also be available to the building's owner in order to encourage him to preserve and restore it. The Transfer of Development Rights is not the only tool for the heritage protection, but it can be the most effective within the framework of the 1954 Master Plan. This process will result in the preservation of the urban fabric as well as a city rich in culture and history.

August 4, 2020

The double explosion at the Port of Beirut destroyed the city on August 4, 2020. Aside from the human losses, the historic districts sustained unprecedented damage. Despite the damage, the city's residents demonstrate their commitment to preserving the heritage. Since then, numerous awareness campaigns for heritage preservation and reconstruction have been launched.

The DGA inventoried the affected heritage buildings with the assistance of a team of architect-restorers (BBHR 2020). The Beirut Heritage Initiative was established to raise funds and direct the heritage reconstruction project through collaboration with institutions and civil society.

The explosions severely damaged buildings from the Ottoman and French Mandate periods. The first step was to identify heritage buildings in the devastated neighborhoods, then quickly prop up and cover the shaken and bare buildings from their tiled roofs. In October 2020, Parliament passes Law 194 prohibiting the cession or demolition of heritage buildings for a two-year period (renewed for another two years in 2022). UNESCO has been conducting an evaluation mission of the Heritage law since 2021, in collaboration with the Directorate General of Antiquities, activist lawyers, architects and urban planners, in order to push for its adoption by Parliament.

Civil society has made significant investments in the reconstruction of devastated neighborhoods. Beirut Heritage Initiative played a pioneering and strategic role by coordinating the intervention on numerous buildings (including the iconic "Blue House" - Medawar 479) (344, 345), and on ensembles (the "Gholam cluster", in partnership with Together Li Beirut) (346, 347). With the help of the Fondation de France, the BHI also oversaw the introduction to restoration techniques through its manuals and online conferences, in partnership with specialists (including many members of the BBHR 2020). Other NGOs also played a major role: Offre-Joie (which renovated the Karantina neighborhood, a street in Mar Mikhael, and the Beirut Fire Brigade barracks), Together Li Beirut (Tamich and Rif buildings, etc.), Beit el Baraka (the "Jardin des Jésuites" neighborhood – Geitawi, and the Tabbal Building), Live Love Beirut (Rmeil cluster), arcenciel, Nusaned, APSAD...

In March 2022, Beirut's heritage buildings are added to the World Monuments Fund's list (2022 World's Monuments Watch). This list highlights 25 major heritage sites around the world that are facing serious challenges.

344

345

346

347

To summarize, Urban Heritage encompasses more than just buildings; it also includes streets, neighborhoods, and green spaces. Preserving our urban heritage entails not only creating an inventory of buildings, but also rethinking the master plan of Beirut and the future of Lebanon's real estate sector. As a result, it is critical to define the protection perimeters based on a dominant character (348):

- Traditional built heritage: Rmeil, Medawar, Saifi, Achrafieh, Zokak El-Blatt, Bachoura...

- Modern built heritage: Badaro, Geitawi, Minet El Hosn, Ras Beirut, Karm el Zeitoun...

- Landscape heritage: Raouche and Dalieh, Horsh Beirut / Parc des Pins, Jardin des Jésuites, the Corniche...

Without a strategic and global urban vision, there is no coherent and viable heritage preservation policy. It is up to everyone to take action in order to encourage institutional actors (ministries, DGU, DGA, Municipality, etc.) to work together to tackle the challenge of Beirut's future.

348

Beirut, a city to rethink

"Whether courtesan, erudite or devout, peninsula of noises, colors and gold, mercantile and rosy city, sailing like a fleet, which seeks on the horizon the tenderness of a port, it is a thousand times dead, a thousand times relived. Beirut of the hundred palaces, and Béryte of the stones, where people come from everywhere to erect these statues, which make men pray and make wars howl."

Nadia Tuéni

Beirut is unique in that its urban character is paradoxically a result of the authorities' laziness in organizing its planning. Our city is an architectural melting pot whose golden rule has been the land occupation coefficient since the 1950s. This rule, established as a dogma by real estate developers with the complicity of political actors since the early 1990s, has hindered any reflection or questioning of the city's Master Plan and, as a result, any attempt to safeguard the built heritage.

Let's take a look at some photos of Beirut before 1940. Variations on a major architectural theme define the urban character: north-facing central hall buildings. In its adaptation to various scales, from the modest house of the petty bourgeoisie to the large palaces, this theme creates a strong sense of unity and identity. As a result, there is harmony and coherence with the Mediterranean context, climate, social structure, etc.

Beirut's architectural heritage reflects the city's social diversity. Between 1925 and 1965, the urban landscape gradually transformed into a mosaic of buildings and gardens from three eras, defining the character of pre-war Beirut. In contrast to a serene form of Levantine urbanity, the lax practice of post-war town planning resulted in densification, great heights and the disappearance of green spaces.

It would have taken visionaries to create a multi-scale master plan while keeping the original contextual parameters in mind. This entailed appreciating the benefits of a semi-organic urbanism, blending landscape, lifestyle and architectural character, and incorporating the modernist vision into it rather than imposing it on them.

Since the 1990s, neo-liberal politics, which are known for their inefficiency and corruption, have failed to take into consideration this variety in order to develop a coherent action plan at the scale of the city or territory. Contrarily, the war's damage to urbanity only got worse following it. It is a type of "social cleansing" to have downtown Beirut demolished and rebuilt. The vulnerable residents and the old buildings in the peri-central neighborhoods have also taken the brunt of negligence and unrestrained exploitation. As a result, for almost thirty years, we have been destroying and rebuilding Beirut. New buildings rise in height in the middle of the old fabric.

Even while the fate of Beirut's heritage has been a topic of discussion since the 1990s began, the authorities have been unable to develop an effective urban strategy - nor has it desired to do so. The Ministry of Culture has attempted to recognize this heritage on occasion, but has not been successful in imposing a vision or making a firm decision regarding a course of action.

1- The 1933 antiquities law continues to be the only body of law defining and guarding the built heritage.

2- As a result of the rise in the land occupation coefficient, the neo-liberal practices of political actors, and the pressure from real estate developers, coupled with this outdated framework, real estate pressure has intensified.

3- The populace has remained oblivious to concepts of urbanity and living cultural heritage, just like the governing class, due to the criteria of profitability at all costs and in the short term. However, in the face of sectarian individualities, these ideas might serve as a solidifying force for the national identity.

As a result of the crime on August 4, 2020, which emphasized social and cultural instability, civil society came together to support the population, restore diversity, and reinvest in public space. However, we must not fool ourselves. Without government assistance, NGO efforts are one-time operations, short-term endeavors that cannot be considered a viable urban alternative.

We will not go back, and we will not recreate Beirut in accordance with our grandparents' idyllic vision of the city. Authorities in municipal and urban planning must take the position of reinventing the city by distancing themselves from the objectives of their sponsors, collaborating with residents and civil society, and incorporating these groups' initiatives.

It would be incorrect to focus only on the perimeter of the neighborhoods destroyed by the explosion of August 4, 2020 when doing this urban reflection. This would be committing the same mistake that turned Downtown Beirut into an island, and a nearly abandoned island at that. Reestablishing the connections between the districts, including those that are devastated and the others, up to the periphery, will require a comprehensive solution, which may involve reintegrating the city core into the larger urban environment.

Beirut's diversity in architecture is rich in its many identities. Will a rebuild or restoration to the original state be required?

It will first be necessary to compile the results of the censuses to identify, and, most importantly, to have the heritage value of these numerous identities acknowledged: Historic structures from the latter years of the Ottoman Empire include "houses with three arches," "central hall" structures from the interwar era, and "buildings of post-Independence modernity" (1950-1960). The next step will be to determine the standards for an accurate restoration that will perfectly maintain the "Beiruti" specifications. This census and recognition work will need to be expanded to cover structures from more recent eras if it is fully established for structures built before

1925 (and without them currently being protected by a legal framework). The next step will be to keep up the pressure on the authorities to take the necessary legal action. In order to provide the foundation for action, including the potential transfer of land use coefficients, a mechanism intended in exchange for the protection of the built heritage, will unavoidably need to go along with these actions.

In order to control energy consumption, the climatic context that shaped Beirut's architecture up until 1970 will need to be incorporated into urban reflection. However, it will be especially important to try to create modern architecture that blends in with its surroundings like that of the first half of the 20th century.

The Mediterranean is an important part of Beirut's heritage. The Port's growth ultimately resulted in the construction of an impenetrable barrier separating the city from the sea. The current debate includes the reconstruction of the Port and its iconic silos. If this subject must be considered in its whole and without any emotional response, it is not prohibited to imagine reuniting the City with the sea by debating the future uses of the first three basins and their obsolete platforms.

Parallel to the ongoing rehabilitation efforts, a significant amount of research is being done to revitalize Beirut with and for its residents.

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Justine Chalfoun: 345

Fadlallah Dagher: 2, 30, 36, 37, 38, 59, 60, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 88, 89, 90, 91, 92, 94, 95, 96, 98, 105, 106, 110, 111, 112, 113, 114, 115, 117, 118, 119, 120, 121, 122, 123, 126, 127, 128, 129, 130, 131, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 159, 160, 162, 163, 164, 165, 166, 169, 170, 171, 172, 173, 175, 177, 178, 181, 182, 184, 185, 188, 189, 190, 191, 192, 195, 197, 198, 199, 201, 202, 203, 204, 205, 207, 208, 213, 214, 215, 216, 218, 219, 220, 221, 222, 223, 224, 226, 231, 233, 234, 235, 236, 237, 238, 242, 244, 254, 246, 247, 248, 249, 250, 252, 260, 261, 262, 263, 265, 268, 276, 277, 284, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 309, 323, 324, 329, 330, 331, 348, p. 45, p. 63, p. 157, p. 261

Ferdinand Dagher (archives): 41, 42, 43, 124, 125, 132, 167, 307

Yasmine Dagher: 1, 3, 4, 40, 45, 72, 87, 93, 97, 100, 101, 102, 103, 104, 116, 176, 183, 193, 194, 196, 206, 225, 227, 228, 229, 230, 239, 240, 241, 243, 255, 256, 257, 258, 272, 273, 274, 275, 278, 279, 310, 319, p. 111, p. 199, p. 243

DHP Architecture (Dagher, Hanna & Partners): 57, 58, 61, 161

Yasmine El-Majzoub: 315, 317, 318, 344

Antoine Fattal (archives): 271

Rony Feghali (plaster craftsmen): 157, 158

Mazen Haidar: 6, 107, 108, 109, 211, 212, 259, 264, 266, 267, 269, 270, p. 189

Houda Kassatly: 210, 217, 232, 253, 254, 280, 288, 312, 313, 316, 322, 332, p. 21, p. 215

Selim Merhej: 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56

Dia Mrad: 346, 347

Professor E. Wirth: 335

Marc Yared: 186, 187

Aram Yeretzian: 283

Catalogue Elcir: 251

Catalogue Otis: 320, 321, 327, 328

Students from the American University of Beirut (AUB) – Faculty of Engineering and Architecture (FEA), Department of Architecture and Design (ArD): 24

Rayes Advertisements (archives Camille Tarazi): 325, 326

Websource: 311, 336, 337, 338, 339

Photos pages 148-149: Nathalie Chahine, Fadlallah Dagher, Yasmine Dagher and DHP Architecture

10, 11: Plan and elevation drawn by students of the American University of Beirut (AUB) - Faculty of Engineering and Architecture (FEA), Department of Architecture and Design (ArD), Regional Architecture Course (ARCH 241), 2006

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99: Habib Debs, Samadi building, façade detail, 1982

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342: APSAD for the Ministry of Culture / Directorate General of Antiquities, 1996

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348: Plan drafted by Fadlallah Dagher, Abdul-Halim Jabr and Habib Debs for the Ministry of Culture / Directorate General of Antiquities, 2014

Table pages 246-259: Robert Reyfoun

The Beirut Heritage Initiative is publishing, with the support of Fondation de France, two restoration manuals to raise awareness among the public and those involved on the ground following the explosion in Beirut on August 4th, 2020. Introducing the materials, techniques and styles used in Beirut's built heritage, this second volume focuses on the buildings from the interwar period (1925-1945) and the modernist era (1945-1970), in which the use of reinforced concrete was introduced and then imposed.

www.beirutheritageinitiative.com/restoration-manual/

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