

Urban morphology during the French colonization (19th-20th centuries). Case study of Mostaganem City in north-western Algeria

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Abstract:

The urban fabric of French colonial cities in northern Algeria was shaped by broader objectives of spatial control and modernisation, transforming pre-existing urban forms and leaving a lasting morphological legacy. This study addresses an important research gap by analysing the colonial fabric of the city centre of Mostaganem. This urban context has not previously been subject to systematic morphological analysis. Using Conzen's morphological approach and Panerai's theoretical framework, supported by quantitative indicators (including block dimensions, land-use ratios, connectivity, and permeability), the study reconstructs the formation and development of the colonial urban structure. The research demonstrates the effectiveness of integrating morphological and quantitative methods and reveals how French planning models were adapted to local conditions to produce a hybridised urban form. It concentrates on the second (1880–1930) and third (1930–1962) phases of Mostaganem's colonial evolution, intentionally excluding the initial phase (1834–1880). The findings show that during the so-called “Golden Age” (1920s–1930s), half of the blocks were mixed-use and characterised by Haussmann-style arcaded galleries; 66% consisted of single land plots (monoplots), reflecting processes of land consolidation; and block shapes became significantly more regular. This period also saw the emergence of a consolidated civic and commercial core through major public building programmes. In the final colonial phase, the urban fabric incorporated modernist principles – such as simplified geometry and reinforced concrete construction, while still preserving elements from earlier stages. Beyond its historical contributions, the study offers valuable insights for heritage assessment and contemporary urban planning strategies.

Keywords:

Algeria, Mostaganem, morphological analysis, colonial fabric, Haussmann-style

1. Introduction

Algeria, located in North Africa, has a rich and diverse cultural heritage shaped by numerous civilisations over millennia. Throughout its long history, the region has been a crossroads for various cultures, beginning with the Roman and Byzantine empires, whose architectural and urban legacies are evident today [1]. The Islamic civilisation exerted a profound influence on Algeria, introducing distinctive religious, cultural, and architectural elements that continue to shape the country's architectural identity. The cultural milieu was further enriched during the Ottoman era [2]. The most recent and impactful of these influences stems from the French colonial period, which lasted 132 years (1830 - 1962) and profoundly affected Algeria's social, political, and cultural fabric. These successive influences created a distinctive cultural mosaic, making Algeria a repository of diverse traditions and histories.

The French colonial empire, which endured for several centuries, is commonly divided into two distinct periods. The initial empire was established in 1534, with a primary focus on expanding and protecting its overseas territories. During this period, the emphasis was on establishing trading posts,

fortifications, and alliances to protect France's economic interests. The Second Empire, which commenced in 1830, marked a significant shift in French colonial policy [3]. This period was marked by a more assertive and violent approach by the French state, which sought not only to exercise control over the colonised populations but also to assimilate them into French culture, language, and governance. This subsequent phase of colonial expansion was characterised by considerable resistance and conflict, as indigenous cultures and societies were frequently subjected to forced repression in the pursuit of assimilationist colonial objectives.

As the dominant colonial power in Africa, France had a profound impact on the landscapes of numerous colonised countries. The French colonial administration used urban planning as a tool to modernise outdated systems, regulate the local economy, and enforce policies of racial segregation [4]. In addition, the French endeavoured to disseminate European cultural values and norms through their urban design [5]. This period was also characterised by the implementation of innovative urban planning theories and techniques, which not only altered the physical environment but also had a substantial impact on the social and cultural fabric of the colonised countries [3].

The Maghreb, including Morocco, Algeria, and Tunisia, was a crucial French colonial expansion in Africa. These territories share a standard urban configuration in relation to French influence during their second empires. They were, in fact, experimental areas in terms of urbanisation [6]. Algeria experienced the most extended period of French colonisation (1830–1962), compared with Morocco (1912–1956) and Tunisia (1881–1956), which were ruled under the protectorate regime [7]. Consequently, throughout its 132 years of occupation, France considered Algeria an extension of its own territory. The French administration designed cities in Algeria with architecture that closely mirrored French urban landscapes [8]. This approach aimed to westernise the country by encouraging European immigration, thereby increasing the demographic presence of European inhabitants (Table 1) [9]. Additionally, the establishment of urban spaces was tailored to align with Western lifestyles and standards, reflecting the broader objective of assimilating Algeria into France's cultural and social fabric [10].

Table 1. A statistical profile of the European (French and non-French) inhabitants in Algeria spanning from 1833 to 1954 [11]

Year	French	Europeans	% Rural (Total European Population)	% Urban (Total European Population)
1833	24812			
1836	32061			
1841	55374			
1845	114011			
1851	152283			
1856	180330	8388	45	55
1861	220843	13142		
1866	251942	17232		
1872	279691	11482	40	60
1876	344749	59941		
1881	412435	55480		
1886	464820	65269	35	65
1891	530924	16745		
1896	578480	69843		
1901	633850	16331		
1906	680263	73799	35	65
1911	752043	71259		
1921	791370	89719		
1926	833359	82265	28	72
1931	881584	83553		
1936	946013	87527	24	76
1948	922272	80435		
1954	984048	96363	21	79

Table 1 presents a statistical profile of the European (French and non-French) inhabitants of Algeria spanning 1833 to 1954 [11]. To accommodate the large influx of immigrants and alter the composition of the population, the French colonial administration often sought to destroy and neglect Algerian cultural, social, and architectural values [12]. They imposed an urban layout that catered to the colonists' needs and aligned with their values. This led to a process of demolition and reconfiguration intended to convert traditional cities into a European-style urbanisation [4]. This transformation has generated significant heritage for Algerians, impacting their

urban experience and architectural design while offering new forms of architecture. This impact was particularly substantial in northern Algerian cities.

The city of Mostaganem is a particularly relevant case study in this regard. During the final phase of French colonisation, Mostaganem experienced significant urban expansion, earning a distinctive status as the eighth-largest city in terms of population and the third-wealthiest economically. It earned the epithet “the pearl of the Mediterranean” [13], renowned for its distinctive architecture and notable landscapes. This historic city possesses rich architectural and urban planning qualities that offer valuable insights. Since Algeria's independence in 1962, Mostaganem has undergone significant urban expansion. Presently, initiatives are underway to conserve and restore historic buildings and urban fabrics. To this end, the safeguarded sector of Mostaganem, established on 12 August 2015 [14], includes the intra-muros area of the old city as well as part of the city centre characterised by the French colonial fabric, thereby demonstrating the authorities' commitment to preserving both traditional and colonial heritage as integral elements of the city's identity. This designation is accompanied by several intervention projects aimed at enhancing and promoting this urban and architectural heritage [15,16].

While many transformations have altered the structure and use of specific spaces since Algeria's independence, this article focuses on analysing the original functions, spatial layouts, and morphological features of the colonial fabric during the French colonial period. It aims to examine the impact of French planning strategies on the urban structure by combining qualitative and quantitative tools. It identifies changes in land use, block forms, and plot divisions across three distinct colonial phases. In addition, the study measures urban variation using coefficients, such as fractal dimension, connectivity, and permeability. Its final objective is to provide an analytical database to serve as a reference for future preservation and development strategies for the city centre of Mostaganem.

2. An overview of French colonial urban planning

A large number of studies have highlighted that the French colonial heritage in Algeria shapes the urban image and identity of several cities, renowned for their enduring colonial fabric, reinforcing the notion of the city centre through its architectural styles and urban planning, inspired by the architecture of 19th and 20th century French cities [13]. The studies can be divided into those focusing on architectural surveys of individual monuments, which highlight severe cases of pathology threatening the stability of many dilapidated colonial monuments, and those focusing on the urban planning model, which demonstrate strategies of homogenisation and urban continuity [17].

Several authors have confirmed that French colonial cities in Algeria display distinctive architectural styles that are both intricate and aesthetically significant, creating urban images difficult to reproduce. After independence, these styles were difficult to maintain, as new urban areas developed quickly and lacked the same planning or architectural quality [18,19,20]. Consequently, the buildings and layout of these cities are distinctive and challenging to replicate in their original form.

Akila et al, [21] demonstrated that the conception of “urban blocks” in the colonial period in the city of Batna took three forms, according to their use. They also confirmed that these urban blocks were divided into plots based on their purpose: housing, facilities, garden, or square. Each plot in the colonial

core was rectangular and oriented perpendicular to the street, with dimensions controlled by rules of proportion and symmetry to ensure a harmonious urban layout. These dimensions were regulated based on the intended use of the plots and followed precise boundary rules visible on the ground.

According to Yamani and Brahimi [22], the colonial fabric in Algeria constitutes a significant part of the building stock, and several rehabilitation projects have been launched by the Algerian state to preserve this priceless heritage [22]. For their part, Mouhai and Biara [23] noted that studies on the modernisation of the colonial fabric have shown that replacing colonial-built heritage has revitalised the central urban fabric while preserving its identity. Despite more than a century of existence, the colonial fabric continues to fascinate researchers with its architecture and urban model [24,25].

Many researchers [26,27,28] have studied colonial architecture in Algiers (the capital city of Algeria), highlighting that over the French colonial period, architectural expression changed: the early buildings (mid-19th century) tended to be simpler, with lower heights, more uniform façades, and fewer balconies. In contrast, later constructions (late 19th to early 20th century) show a growing interest in architectural expression, combining Haussmannian planning principles with stylistic influences such as Neo-Moorish, Neo-classical revival, and later Art Deco elements, resulting in taller buildings and more decorative façades that reflect the aesthetic ambitions of that period (Fig. 1).

On the other hand, some scholars categorised the urban policies of the French colonial administration in Algeria into three distinct periods: 1830-1930, 1930-1945, and 1945-1962 [10,30,31]. From 1830 to 1930, new colonial cities or districts were organised in a grid pattern, focused on military control, and segregated the local population. Between 1930 and 1945, urban development focused on modernisation, with new infrastructure

and public housing, though segregation persisted. The final period, 1945 to 1962, saw efforts to integrate Algerians into urban areas, reflecting the tensions between colonial modernisation and growing nationalism.

Moreover, a significant number of researchers have underscored the importance of fortification and defence in the French establishment on Algerian territory. Indeed, the French military adopted different control strategies depending on the pre-existing local urban fabric [32,33]. Chauchoe [24] distinguished three main urban planning strategies adopted by French military engineers when establishing control over Algerian territories: 1) Superimposing the new colonial fabric onto the existing one – a Haussmann-style approach observed in cities such as Tlemcen and Constantine (Fig. 2 and Fig. 3); 2) Juxtaposing closed and open spaces, as seen in Annaba; 3) Separating the indigenous fabric from the new French one to assert dominance and control, evident in Biskra, Ghardaïa, and Ouargla. Thus, the urban morphology of Algerian colonial cities varied according to the military strategy applied to the pre-existing urban context.

Based on the above review, this study addresses a significant gap in the existing literature on Algerian colonial urban morphology, as most previous research has concentrated on the significant colonial centres Algiers, Oran, and Constantine while overlooking significant regional cities such as Mostaganem. Despite being the second-largest city in western Algeria and an important Mediterranean port, Mostaganem has received little scholarly attention. During the colonial period, it underwent notable urban transformations under French rule, yet its colonial layout and morphological evolution have rarely been examined. By analysing the impact of French planning policies on the city's urban morphology, particularly its blocks, plots, and buildings, this article contributes new insights into the colonial urban heritage of the region.



Fig. 1. A visual comparison of two eras of French colonial architecture in Algiers [7,29]



Fig. 2. The medina of Tlemcen before and after the French urban intervention [18]



Fig. 3. The medina of Constantine before and after French urban intervention (Haussmannian opening of boulevards) [34]

3. Methodology

To achieve the outlined objectives, the present research draws upon the methodology of Karl-Otto Conzen, a pioneering geographer whose work has significantly advanced the study of urban morphology [35]. Conzen's analysis of cities was structured into three hierarchical levels: urban blocks, plots, and buildings [36].

To move beyond description, this morphological approach was complemented by a numerical analysis that quantified indicators such as block surface, plot number, connectivity, and permeability. These measures capture land consolidation, circulation efficiency, and spatial order, clarifying how French planning models were locally adapted. Furthermore, the study draws on the seminal contributions of Philippe Panerai, whose emphasis on connectivity and permeability [37] complements Conzen's focus by linking form to function, thereby reinforcing the originality of this hybrid approach.

The data collection process relied on textual, archival, and visual materials (French colonial photographs and postcards), complemented by direct in-situ observations. In-situ observations followed a systematic protocol inspired by

Conzenian morphology, focusing on detailed inspection of architectural features and urban layout to clarify the colonial imprint in Mostaganem's city centre.

The results were organised in comparative tables, interpreted by phase, and discussed in light of colonial urban planning literature. This dual morphological-quantitative approach provides integrated insights, combining spatial analysis with statistical evidence to show how colonial planning principles influenced the development of Mostaganem's city centre

4. Presentation of case study: the city centre of Mostaganem

4.1. Location

Mostaganem is located in a coastal province in north-western Algeria, overlooking the Mediterranean Sea. The city is organised around a collection of historic sites and old quarters that reflect its long and complex evolution. Renowned for its rich cultural and artistic heritage, Mostaganem bears the imprint of multiple historical layers – from its pre-colonial past to its French colonial period and later urban transformations (Fig. 4).



Fig. 4. Location of the city of Mostaganem [38]

4.2. Genesis and evolution of the city of Mostaganem

Mostaganem is thought to have been the successor to Murustaga in ancient Roman Africa in the 3rd century AD, but no ancient traces of this settlement have been found. According to historical accounts, during the reign of the emperor Gamian, North Africa was shaken and destroyed by terrible earthquakes [39]. The ruins provide more tangible evidence of the presence of Roman settlements.

The layout of the current city centre of Mostaganem is the cumulative result of a juxtaposition of urban fabrics from different historical periods and is shaped by the Oued Ain-Sefra. These periods include the pre-Ottoman period, exemplified by the Arab quarter (Kasbah Tijditt); the Ottoman period, represented by the citadel (Derb and Tabana); and the colonial period, exemplified by the colonial city (Fig. 5).

4.2.1. Pre-Ottoman period (before 1516):

The origins of the city of Mostaganem date back to its Phoenician trading post. The initial growth and development of the town were primarily shaped by its strategic location on the

Mediterranean Sea, which facilitated trade and cultural exchange with other Mediterranean cultures [39,41]. Following the decline of the Roman Empire, the city underwent a period of transition under the control of various Berber dynasties [42]. During the Islamic expansion in the 8th century, Mostaganem acquired considerable significance, becoming an important centre of Islamic learning and culture under the Almoravid and Almohad local dynasties. The Arab quarter of Tijdit, located on the north bank of the Oued Ain-Sefra, was established during this period [43] (Fig. 6).

In 1506, as part of their conquest of the western Mediterranean, the Spanish occupied Mostaganem, as a strategic position on the Algerian coast. However, their control over the town was soon challenged by determined local resistance, fuelled by religious and cultural motives, and by the active support of the surrounding tribes. This resistance weakened the Spanish presence and limited their ability to maintain a firm hold on the city [44].

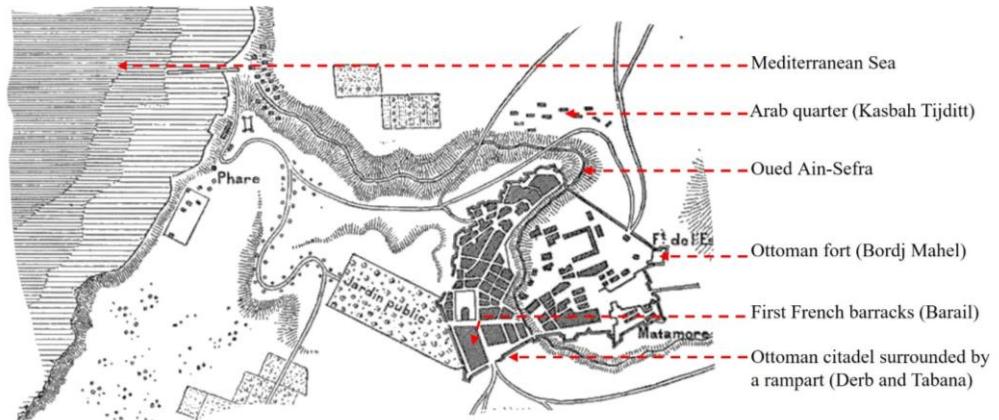


Fig. 5. A map based on the French navy, illustrating the historical strata of the city of Mostaganem [40]



Fig. 6. Views of the Arab quarter (Kasbah Tijditt) [45]

4.2.2. The Ottoman period (1516-1833)

In 1516, the Ottomans, under the leadership of Aroudj Barberousse, responded to the appeal of the inhabitants and intervened militarily to drive the Spanish out of Mostaganem. This victory marked a turning point, integrating the town into the Ottoman regency and consolidating their presence in western Algeria in the face of European ambitions.

Meanwhile, in 1708, the Spanish conquest of Oran, a city near Mostaganem, was a key factor prompting the Ottoman governor, Khairuddin Barbaros, to reinforce Mostaganem in 1738 against potential Spanish invasions [46]. Consequently, Mostaganem flourished as a fortified city, serving as a strategic

bastion, in contrast to Oran, which endured numerous conflicts [47].

The city remained relatively unscathed due to the efficacy of Ottoman defensive strategies and subsequently became a prominent commercial hub and a vital port within the region [48]. During this period, the city's urban layout was characterised by the construction of the Ottoman citadel (Derb and Tabana), surrounded by a defensive wall with five gates [46]. These two Ottoman districts exemplify the city's rich architectural and urban heritage [2]. They are characterised by narrow streets and thick-walled houses with intricate tilework, embodying traditional Islamic and Ottoman designs typical of Arab urban settlements (Fig. 7).



Fig. 7. The Ottoman citadel (Tabana) [45]

4.2.3. French colonial period (1834-1962)

From 1834 to 1962, French urban planning had a profound influence on the urban configuration of Algerian territory, especially in northern cities [49], shaping their morphological identity [50]. The town of Mostaganem is a prime example in this regard. It was conquered in July 1833 by Desmichels following a prolonged and determined resistance, particularly during the renowned Battle of Mazagran. Emir Abdelkader himself appeared on the battlefield, yet he lacked the requisite manpower to confront Desmichels' artillery. Consequently, on 9 August 1833, the Algerians withdrew from the town, and the Emir returned to Mascara [51]. In the same period, the French authorities established the first municipal council of the commune of Mostaganem, created by order of 31 January 1838. They started the foundation of a significant urban transformation under colonial rule [32]. Inspired by the Haussmannian renovation of Paris, the urban transformation of the city of Mostaganem can be delineated following three distinct phases [52], each characterised by the construction of numerous buildings that reflect significant changes in spatial and infrastructural development (Fig. 5 and Fig. 8). These phases trace the evolution of the city's colonial fabric from 1834 to 1960, reflecting a progression from initial military occupation to urban civilian expansion and subsequent modernisation.

a. First phase: initial occupation and military control (1834–1880)

The initial phase of the French military operation was designed to secure control over the city and its surroundings. The strategy deployed was primarily based on the use of force, leading to the destruction of numerous buildings and the conversion of the existing Ottoman fortification into military barracks, as in the case of Bordj Mahel, which was the first base of the French military in the city [53]. In parallel with this strategy, and to consolidate its domination over the newly conquered lands of Algeria, the French colonial army initiated construction of the first fortification in Mostaganem in 1849. This structure, known as the Barail, was the first barracks to be constructed within the city's rampart (Fig. 5 and Fig. 9) [54].

In their study, Yamani et al., [22] Argue that the French colonial strategy in Mostaganem involved a deliberate juxtaposition of urban fabrics. The river Ain Sefra physically separates the Arab quarter of Tijdit from the French colonial zone.

French colonial urban planning, which began with the 1851 alignment plan, clearly structured the city's urban layout. The transition between the second part of the old city (Derb and Tabana) and the new French districts is marked by a large square, previously known as Place Gambetta, which acts as a boundary between the irregular layout of the old town and the orthogonal grid of the colonial city. French planners created the first street and intersection layouts [55] and the first promenades as part of

a development plan proposed by architect Léon-Émile Fournier. This plan transformed the old Ottoman fortifications into a boulevard with extensive gardens, ramps, and stairs, wide avenues, and modern infrastructure such as the covered market (1855) and the René Basset community college (1871). These improvements made public urban space more functional and attractive to European settlers by providing shade and coolness through planting. Moreover, this practice of enhancing urban spaces with greenery became a common feature of colonial urban planning.

The implementation of the 1851 alignment plan brought about significant changes in the city's layout. Numerous historical buildings, including various city gates such as Bab El Bhar and Bab Mascara, were destroyed to accommodate new colonial constructions and modernise the urban landscape. This

alignment plan, characterised by a centralised grid design that emphasised state authority, sharply contrasted with the traditional districts of Dereb, Tijdit, and Tabana, known for their narrow, irregular streets [56]. The foundation of the Barail Barracks in 1894, which occupied a large part of the Intramuros city of Mostaganem, marked the introduction of colonial culture through prominent religious structures. A new "colonial" architectural style first appeared with the construction of the church of Saint Jean Baptiste in 1847 [57]. This church, with its Romanesque windows and domed bell tower, located at the centre of a large square of the republic, became a focal point for further development. Surrounding the square, several buildings and orderly urban blocks with arcades were built, including the old theatre, constructed in 1885 and destroyed by a major fire in 1940 (Fig. 10).

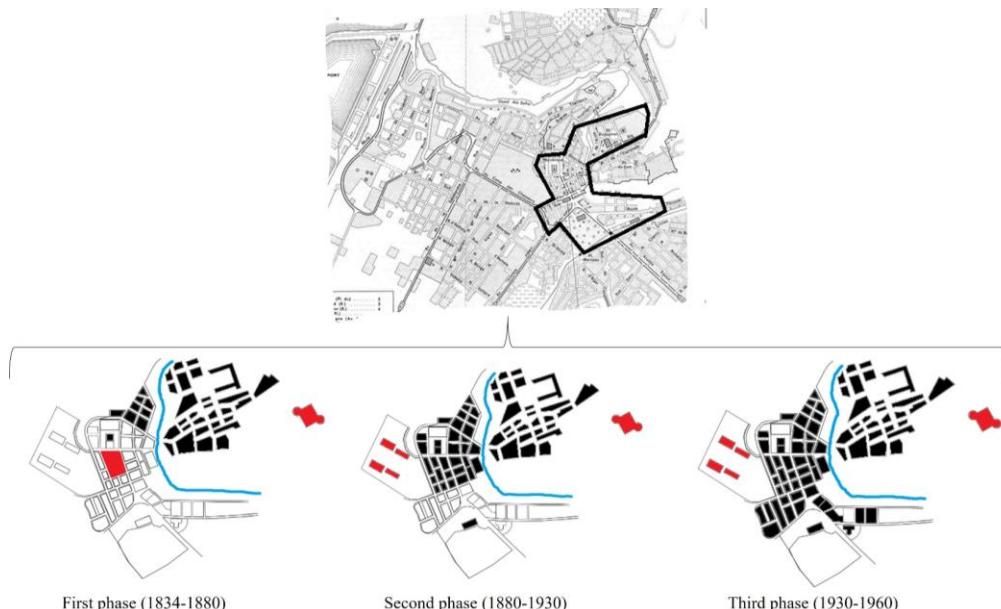


Fig. 8. Simplified schema showing the evolution of the French colonial city of Mostaganem

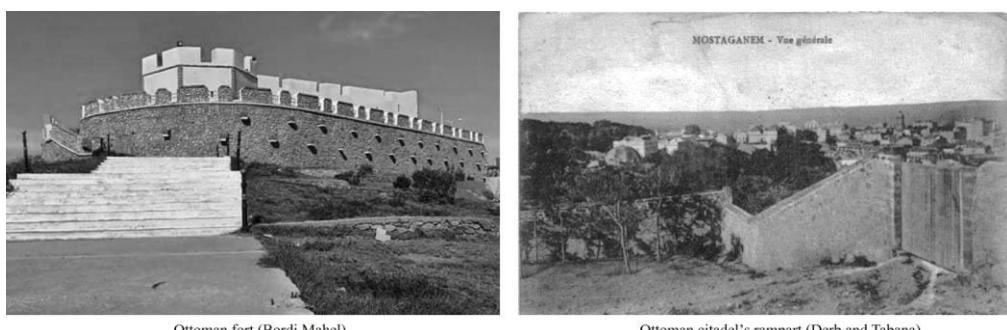


Fig. 9. Views of Ottoman heritage in the city of Mostaganem [45,46]

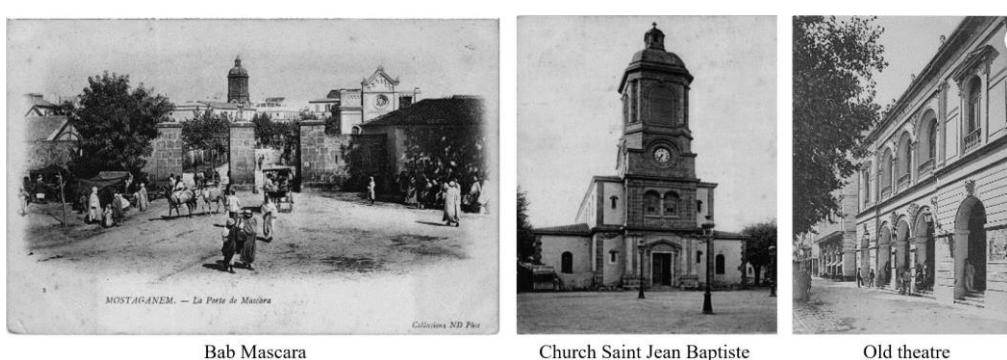


Fig. 10. View of buildings representing the first phase [45]

b. *Second phase: colonial expansion and urban restructuring (1880–1930)*

The adoption of the “Haussmannian” principles during this period represented the climax of French colonial town planning in northern Algeria. The initial phase of this project involved relocating the fortifications, with the demolition of the Barail barracks and the construction of the Colonieu barracks in 1894 outside the fortification walls (Fig. 11).

These new barracks occupy a significant portion of today’s Mostaganem city centre. The demolition of the old fortifications allowed the site to be reclaimed, enabling the extension of the colonial town centre to be more clearly structured. Many new administrative buildings, public squares, and commercial areas were constructed after the demolition of this fortification, including banks such as the Central Bank of Algeria and the Lyonnais Credit Bank, founded in 1917 by the Pinéda family [58], which feature Haussmannian-style arcades [59]. The Post Office, erected in 1928 in the neoclassical style, and the Town Hall, designed by the architect Monthalant in 1925 (Fig. 12), are other examples of buildings erected during this period. It is

notable that in many cities in the Maghreb, such as Sousse in Tunisia, Casablanca in Morocco, and Annaba in Algeria, town halls built by colonial powers represent a significant exception to the prevailing architectural style. The location of these buildings was frequently chosen to command the city skyline, with a prominent clock tower symbolising an appropriation of the city [6]. The neo-Moorish style (also known as Arabisance or Jonnart style) adopted for the majority of these buildings serves as an interface with the pre-existing social and cultural context, drawing inspiration from traditional Algerian and Arab-Muslim architecture, demonstrating the colonial authorities’ “respect” for local cultural elements while maintaining their administrative control [29,60].

During this phase, the city of Montaganem also experienced significant events, including the devastating flood of the Oued Ain Safera in 1927, with floodwaters reaching 5–6 meters [61]. It was the most significant natural disaster to date, resulting in a loss of 290 lives and substantial destruction of the colonial fabric [62]. In 1928, the city reconstructed a new covered market to replace the one destroyed by flooding and built three new bridges (Fig. 11).



Three new bridges



Colonieu barracks

Fig. 11. General views of bridges and Colonieu barracks [45]



Central Bank of Algeria



Lyonnais Credit Bank



Post Office



Town Hall

Fig. 12. View of buildings representing the second phase [45]

c. Third phase: integration and modernisation (1930–1962)

After the Second World War, Mostaganem experienced significant infrastructure development, housing construction, and the construction of new government buildings to accommodate an expanding population [63]. The design during this time was defined by a minimalist aesthetic that used concrete and steel in a functional, unadorned manner. The architectural style during this period shifted towards modernist approaches, resulting in the construction of many buildings in a modern style, characterised by clean lines and a straightforward approach to form and structure. The consular palace in 1938, the Rotonde building in 1939, the Coliseum building in 1950, and the treasury building (1951 and 1955) (Fig. 13), illustrate this style. The architects and urbanists of this period aimed to extend these developments significantly; however, the outbreak of the Algerian War of Independence halted these plans.



Fig. 13. View of buildings representing the third phase [45]

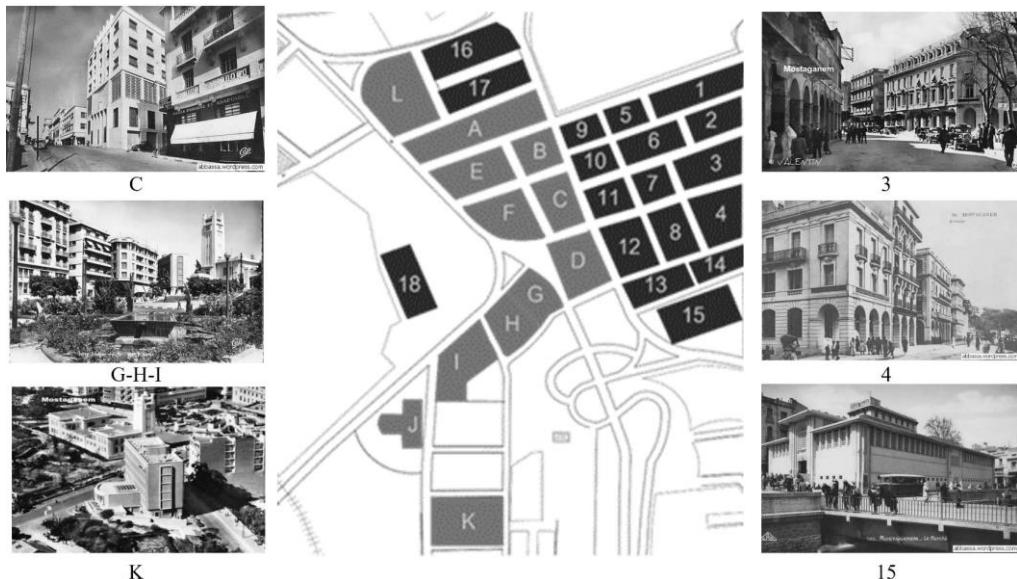


Fig. 14. The shapes of the urban blocks in city centre of Mostaganem (phase 2 in numbers and phase 3 in letters)

The urban morphological approach employed in this study is grounded in the methodological framework established by Karl-Otto Conzen, a seminal figure whose contributions have been instrumental in shaping the field of urban morphology. Conzen proposed a multi-layered analytical structure based on three hierarchical components – the urban block, the plot, and the building fabric – which together enable a comprehensive understanding of the historical and spatial evolution of urban form. This framework facilitates investigation of how towns develop over time, highlighting the interactions among physical structure, land division, and architectural processes.

Recent scholarship has continued to apply and expand Conzen's model, demonstrating its enduring relevance in contemporary urban studies. For example, Arat [66] employs this historico-geographical approach to examine morphological transformation through the interrelation of plot patterns and built form, reaffirming the value of Conzen's analytical hierarchy within modern research practices.

The analysis focuses exclusively on the historic city centre, which constitutes the core of the French colonial urban fabric. It specifically examines the second (1880–1930) and third (1930–1962) phases of Mostaganem's colonial development, while intentionally excluding the initial phase (1834–1880), as the original urban fabric of the first phase underwent significant changes over time (Fig. 14), causing it to lose its original appearance.

The present morphological analysis of Mostaganem city centre examines several key aspects, including land use, the shapes and heights of urban blocks, and the configuration of plots.

5.1.1. Land use

The complex historical development of Mostaganem's city centre under colonial policy is evident in the strategic land use implemented by the French, designed to fulfill colonial objectives. Residential areas were established for European settlers, commercial establishments were strategically placed, and administrative functions were organised to reinforce colonial control.

The urban layout reflects these priorities, with residential zones offering diverse housing types to accommodate the growing population and commercial hubs, particularly along the streets bordering Saint-Jean-Baptiste Church and the town hall, which concentrate economic activity. Mixed-use spaces, often in Haussmannian-style buildings, integrate residential and commercial uses, contributing to a vibrant streetscape.

Administrative zones housed French government offices, while recreational areas, such as parks and theatres, provided cultural engagement. Military and religious zones reinforced colonial dominance, ensuring control and influencing local culture. Taken together, these land use types structured the colonial centre and illustrate the lasting impact of colonial planning on the city's growth and organisation.

5.1.2. Urban block

An important method for understanding the urban fabric is to study its morphology. According to Panerai, the urban block constitutes the fundamental element of the urban fabric. He suggests expanding the analysis to include urban block shape and urban block division (shape of plots).

a) Urban block shape:

By investigating the geometric configurations of blocks and considering factors such as military needs and territorial characteristics, early French urban planners in Algeria adopted a grid plan model typical of Western cities and utilised six distinct shapes of urban blocks (Fig. 15).

Urban blocks in Mostaganem's colonial urban fabric exhibit diverse shapes, each contributing to the city's distinctive spatial organisation. The aerial view of the city centre reveals a predominance of square blocks, reflecting symmetrical and balanced designs typical of Haussmannian planning [67] (Fig. 16).

Rectangular blocks, defined by equal opposite sides, provide versatile layouts, often featuring long apartment rows with uniform cornices, large doors, and balconies [68]. L-shaped blocks, formed by two rectangles meeting at a right angle, are less common in Haussmannian designs but add variety [67]. One-sided inclined blocks introduce formal asymmetry by incorporating a single slanted boundary, a configuration that facilitates adaptation to natural terrain or to spatial limitations imposed by the urban fabric. Two-sided inclined blocks generate irregular polygonal forms, providing greater flexibility for accommodating non-orthogonal street configurations. Triangular blocks, defined by three sides and angular intersections, make efficient use of irregular parcels and often yield distinctive architectural solutions and unique public spaces. Collectively, these block typologies demonstrate the adaptability and inventive capacity of urban design in responding to spatial constraints and contextual conditions.

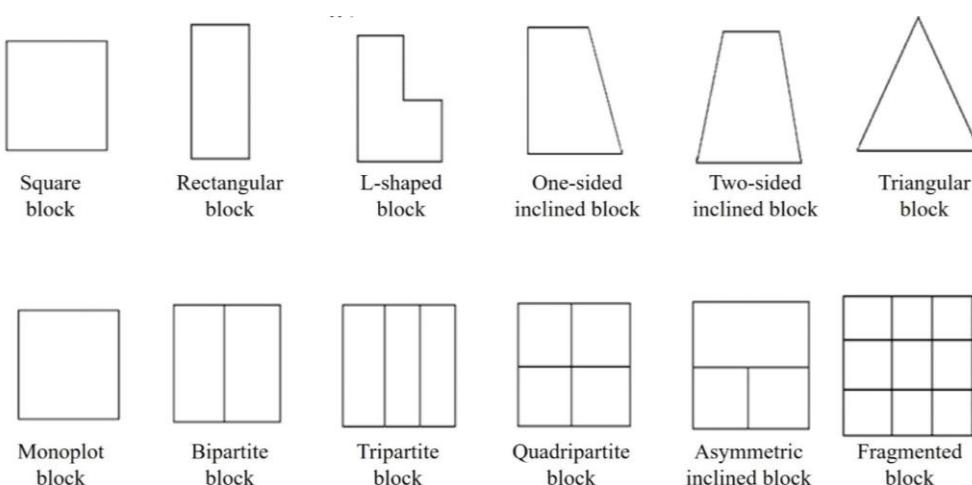


Fig. 15. Shapes and division of urban blocks in Algeria during French colonisation

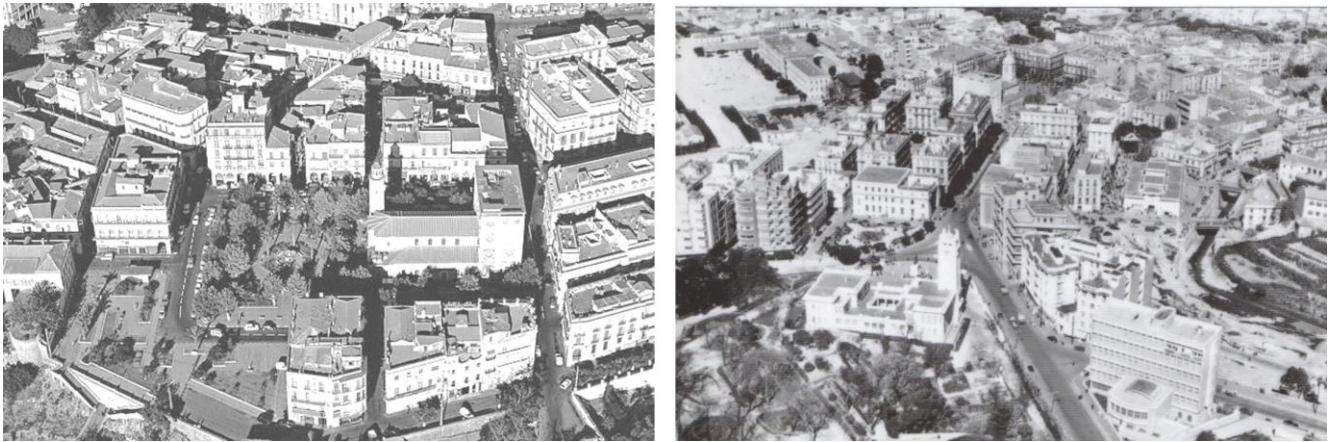


Fig. 16. Aerial views of the city centre of Mostaganem, showing the urban block division [42,71]

b) Urban block division (shape of plots):

In the context of French urban planning in Algeria, the division of urban blocks into plots followed a systematic approach that resulted in six distinct types (Fig. 15). This approach, guided by both strategic and practical considerations, ensured that each block type was carefully designed to meet the specific needs of the colonial cities.

Urban blocks can vary in their subdivision patterns, reflecting different approaches to land use and urban design. Monoplot blocks remain undivided, preserving their original form, as commonly seen along Haussmann's wide boulevards [69]. Bipartite blocks are split into two plots, often featuring internal courtyards that enhance living spaces and light circulation, while maintaining linear façades, as in the Rue de Rivoli [69]. Tripartite blocks are divided into three linear plots, and quadripartite blocks follow a grid-like structure with four subdivisions. Asymmetric blocks, with one significantly larger plot among three, exhibit irregular patterns, while fragmented blocks are highly segmented into smaller plots. These fragmented blocks were less common in central Haussmannian areas but appeared in denser working-class neighbourhoods, balancing varied land use with regulations on building height and stone façades [70]. Together, these patterns showcase the adaptability of urban blocks to different functional and aesthetic needs.

Based on the morphological criteria outlined above, Table 2 provides a detailed quantitative synthesis of the colonial urban fabric of Mostaganem. It systematically classifies the identified urban blocks according to their predominant land uses, geometric configurations, and internal subdivision patterns. This quantitative analysis clarifies the spatial organisation and structural logic that characterised the city's evolution during the second (1880–1930) and third (1930–1960) phases of French colonisation (Table 2, Fig. 14 and Fig.15).

The second phase of French colonisation of Mostaganem, particularly between the 1920s and 1930s, known as the “golden age”, was characterised by significant changes in the architectural and urban fabric. Table 2 shows that this phase introduced a combination of land uses, with approximately 50% of urban blocks consisting of mixed-use developments. These blocks generally consisted of residential buildings combined with ground-floor commercial spaces, complemented by a double-height arcade, an architectural device reminiscent of Haussmannian Paris. This area can therefore be characterised by a Haussmann-style fabric, comprising predominantly rental

properties. One of the most significant changes in this period is the transition towards single-plot urban blocks. Around three-quarters of the blocks now consist of a single plot, indicating a move towards larger, unified land holdings used in the second phase, reflecting a clear departure from the earlier, more fragmented colonial parcel structure. Only a small number of elongated blocks remained, divided into two or three sections, highlighting the transition from minor land divisions of the early phase to more cohesive, larger plots. The increase in the number of storeys was another significant change during this period. In order to maximise vertical space and to align with the streets and boulevards, which were also widened, buildings rose to four storeys instead of two, inspired by Haussmann's style. The regularity of the urban form persisted: One third of the blocks were square, another third rectangular, and the rest had a sloping part due to the oblique alignment of the streets. However, the overall plan became more uniform and symmetrical, reflecting Haussmann's grand and ordered vision of Paris. During this period, the construction of critical administrative buildings, such as the Post Office, the Consular Palace, and the Town Hall, as well as other commercial buildings, such as the big Market, illustrates the city's civic transformation. Public spaces such as the Place d'Armes also became critical recreational areas, reflecting the centrality of civic life in Haussmann's policy. The relocation of military buildings to the periphery reinforced the city centre's role as a civic and commercial hub during this period.

The third phase reflects a period marked by modernist influences, though with fewer urban blocks than in the previous phases, primarily due to its shorter duration. The period is characterised by a balanced distribution of land uses, with a third of the blocks devoted to residential, commercial, and mixed uses, according to the table data. Small public spaces remain an integral part of city life and serve as important open spaces for ventilation and relaxation. During this phase, simpler and more functional design principles were adopted. Nearly half of the blocks from this period were designed with a regular rectangular shape, in keeping with the modernist preference for geometric, streamlined forms. Despite minor modifications, the plan retained key elements from the “Golden Age” period, particularly the concept of the single block. Approximately four out of every three blocks (allowing for garden plots) remained united into a single plot. Modernist architecture of this period emphasised functionality, with the use of reinforced concrete. Buildings were often simpler, with plain facades lacking ornamentation, flat roofs, clean lines, and open interiors. The maintenance of larger, unified plots reflected the modernist goal of efficient land use.

Table 2. Quantitative analysis of the colonial fabric: block size, plot number, and connectivity indicators

Phases	Land use					Urban Block Forms					Urban Block division						
	Plot codes (numbers and letters)	Residential	Commercial	Mixed	Administratif	Religion /military	Recreational	Square Block	Rectangular Block	L-Shaped Block	One-Sided Inclined Block	Triangular Block	Monoplot Block	Bipartite Block	Tripartite Block	Quadrupartite Block	Asymmetric Block
Second Phase 1880-1930	1					x					x				x		
	2		x								x		x				
	3			x							x		x				
	4			x							x			x			
	5		x					x					x				
	6					x		x					x				
	7		x					x					x				
	8		x					x								x	
	9		x					x					x				
	10	x						x					x				
	11		x					x					x				
	12			x					x							x	
	13		x						x				x				
	14	x									x		x				
	15		x						x				x				
	16			x							x				x		
	17		x						x						x		
	18			x					x				x				
Rapport	2/18	2/18	9/18	3/18	1/18	1/18	6/18	6/18	/	6/18	/	12/18	1/18	3/18	1/18	1/18	1/18
Third Phase 1930-1960	A		x					x						x			
	B		x					x					x				
	C			x				x					x				
	D			x				x					x				
	E	x	x							x			x				
	F				x					x			x				
	G		x					x					x				
	H			x				x					x				
	I	x							x						x		
	J			x							x		x				
	K		x					x					x				
	L	x					x							x			
Rapport	3/12	3/12	3/12	3/12	/		1/12	2/12	6/12	1/12	2/12	1/12	8/12	2/12	1/12	1/12	/

5.2. Urban numerical analysis

This numerical analysis of urban planning aims to gain a deeper understanding of the spatial fabric of Mostaganem's city centre by quantifying various aspects of its layout.

Calculating areas, perimeters, and the number of plots allows us to assess the structure and density of the city. In addition, several key coefficients, including the coefficient of variation, fractal dimension coefficient, connectivity coefficient, and permeability coefficient, were evaluated. The resulting metrics allow us to determine the efficiency with which the urban environment functions and how its spatial patterns contribute to the dynamics of the city overall. This data-driven approach therefore provides a clear, objective basis for analysing and understanding the complexities of urban development.

5.2.1. Urban block surface and perimeter:

This parameter examines individual block areas and perimeters to understand spatial extent and patterns of arrangement used by French urban planners.

5.2.2. Number of plots:

In this step, the number of plots within the urban fabric was examined and classified into “even” and “odd” categories. This analysis aims to uncover any underlying logic in the division patterns by analysing the number and characteristics of the plots. The objective is to determine whether specific planning principles or historical factors influenced the arrangement and subdivision of plots within the urban area.

5.2.3. Building height:

Building height is defined as the vertical distance from the lowest point of the base to the highest point of the building. It affects the key aspects of urban form, including density, shading, wind flow, and the skyline.

5.2.4. Connectivity:

In urban planning, connectivity is defined as the degree to which people can easily navigate a metropolitan area [72]. It is often assessed by evaluating the level of access between different locations. By studying connectivity, it is possible to quantify the degree of connection between streets and intersections: a higher degree of connectivity allows for a greater number of accessible routes and improves overall mobility in the city. The connectivity coefficient is calculated according to the following equation [72]:

$$\text{Connectivity Coefficient} = \frac{E-V+1}{2V-5}$$

E is the number of edges (streets); V is the number of vertices (intersections).

5.2.5. Permeability:

Permeability is a fundamental concept in urban design [73], determining the degree of access between locations. Using the Link-Node method [74], the ratio of links to nodes indicates the level of permeability. Permeability analysis involves assessing block and road development *patterns* to understand how urban blocks and roads are laid out and developed. The permeability of a city can be defined as the ease with which people can move through it, as reflected in its street layout, which facilitates pedestrian and vehicle movement. The permeability coefficient is calculated according to the following equation:

$$\text{Permeability Coefficient} = \frac{\text{Area of open space}}{\text{Total urban area}}$$

Within this numerical analysis, Table 3 summarises the calculated parameters, including block dimensions, plot distribution, building heights, and the corresponding coefficients of variation, fractal dimension, connectivity, and permeability. These indicators collectively provide a quantitative basis for interpreting the spatial structure of each development phase (Table. 3 and Fig. 14).

In the second phase, large blocks accounted for 55.56% (10 out of 18), indicating a preference for expansive layouts that maximised building footprints and reduced fragmentation. Small blocks were rare, and medium ones appeared only twice. This pattern mirrors observations by Marçais [75] in Algiers, where simplified layouts supported colonial control.

Most blocks (77.78%) had an odd number of plots, and 88.89% had uniform heights, creating a consistent skyline. The only exception was the slightly lower Post Office. Recent analyses of colonial urban planning in Algeria indicate that such height regularity was intentionally used to impose visual order and spatial hierarchy [76].

A 39.59% variation in block size and a fractal dimension of 1.45 suggest a relatively simple urban form. Low connectivity (0.18) and moderate permeability (0.48) reflect a controlled but limited urban flow, consistent with colonial planning priorities [77].

In the third phase, large blocks remained dominant. Medium blocks accounted for 33.33% (4 out of 12), and no small blocks

were present. Odd plot numbers appeared in 75% of blocks, and 91.67% had uniform heights, maintaining spatial consistency with minor variations.

Block size variation decreased slightly (34.14%), while the fractal dimension rose to 1.6, indicating slightly greater complexity. Connectivity (0.25) and permeability (0.60) improved, reflecting a shift toward more integrated layouts. This trend aligns with late-colonial patterns noted by Saadaoui [77], especially in cities like Oran.

6. Conclusion

This study analysed the colonial urban fabric of Mostaganem through an integrated morphological and quantitative approach, tracing the evolution of its city centre across three stages of French colonisation. While the historical investigation addresses all three phases, the quantitative analysis focuses primarily on the second and third, as the earliest phase underwent extensive modifications that compromised the legibility of its original configuration.

The findings reveal a progressive shift from fragmented and functionally specialised blocks to a more coherent and unified urban form, characterised by large monoplots, standardised building heights, and simplified block structures. Beyond descriptive outcomes, the results highlight the selective adaptation of French urban models: Haussmannian principles of order, hierarchy, and mixed-use development were initially implemented and later reshaped under modernist planning ideals that prioritised rationality, efficiency, and functional zoning. This process of hybridisation illustrates that colonial planning was neither uniform nor passively imposed, but continually reinterpreted in response to local conditions, leaving a durable morphological legacy.

Positioning Mostaganem within the wider framework of French colonial urbanism in North Africa, the research contributes to a deeper understanding of how colonial planning logics structured, controlled, and stratified urban space. The enduring presence of these spatial forms today reinforces the relevance of colonial legacies for contemporary planning, policy-making, and heritage management in Algeria.

Ultimately, Mostaganem emerges as a tangible expression of the colonial imprint, where the interplay between urban morphology, historical identity, and spatial governance remains visible. As such, the case study offers meaningful insights for both historical interpretation and the development of strategies that reconcile heritage preservation with future urban growth, promoting a sustainable and reflective approach to the transformation of colonial urban fabric.

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Table. 3. Block dimensions, plot characteristics, and connectivity- permeability coefficients

Phases	Block dimensions			Plots			Building height			Coefficients					
	Plot codes (numbers and letters)	Surfaces	Large ($> 1000 \text{ m}^2$)	Medium	Small ($\leq 500 \text{ m}^2$)	Plot counting	Even	Odd	Average	Uniform	Variable	Coefficient of variation (%)	Fractal Dimension	Coefficient of connectivity	Coefficient of permeability
Second Phase 1880-1930	1	803.53		x		3		x	18	x					
	2	520.82		x		2	x		16		x				
	3	877.28		x		1		x	18	x					
	4	928.70		x		2	x		16		x				
	5	293.49			x	1		x	18	x					
	6	621.34		x		1		x	18	x					
	7	407.31			x	1			18	x					
	8	664.04		x		3		x	18	x					
	9	329.11			x	1		x	18	x					
	10	373.97			x	1		x	18	x					
	11	482.37			x	1		x	18	x					
	12	872.04		x		5		x	18	x					
	13	694.24		x		3		x	18	x					
	14	484.30			x	1		x	18	x					
	15	1316.19	x			1		x	10	x					
	16	955.44		x		3			18	x					
	17	879.93		x		3		x	18	x					
	18	1033.50	x			1		x	18	x					
Rapport		2/18	10/18	6/18	/	2/18	14/18	/	16/18	2/18	/	/	/	/	/
Third Phase 1930-1960	A	1549.33	x			3		x	22	x					
	B	530.89		x		1		x	12		x				
	C	754.83		x		2	x		12	x					
	D	1082.61	x			1		x	22	x					
	E	1058.07	x			2	x		22	x					
	F	1017.04	x			1		x	28	x					
	G	743.52		x		1		x	26	x					
	H	869.73		x		1		x	26	x					
	I	1353.76	x			3		x	26	x					
	J	1405.59	x			1		x	22	x					
	K	1610.88	x			1		x	26	x					
	L	1775.47	x			4	x		28	x					
Rapport		8/12	4/12	/	/	3/12	9/12	/	11/12	1/12	/	/	/	/	/

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