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INHERITED SPATIAL CONFIGURATIONS AND EMERGING REAL ESTATE LOGICS: AN ANALYSIS OF VERTICAL DENSIFICATION TRAJECTORIES IN THE PERICENTRAL AREA OF BLIDA, ALGERIA

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Abstract: This article investigates the trajectories of vertical densification in the colonial pericentral area of Blida (Algeria), focusing on the relationship between inherited spatial configurations, planning regulations, and emerging real estate dynamics. The study is based on an original database of building and demolition permits issued between 2019 and 2024, combined with diachronic mapping of high-rise buildings (HRBs) constructed between 2012 and 2024 using a GeoEye-1 orthoimage (2012) and orthorectified Google Earth imagery (2019 and 2024). The methodological framework integrates urban morphological analysis, spatial statistics, and space syntax indicators to examine how street-network configuration and plot structure influence redevelopment opportunities. Results show that vertical densification occurs primarily through an incremental demolition–reconstruction process driven by private investment rather than coordinated public planning strategies. Redevelopment is concentrated in the most accessible and spatially integrated pericentral areas, where parcel size, plot configuration, and network connectivity provide favorable conditions for investment. Initially, HRBs are strongly aligned with historically integrated radial corridors, reflecting path-dependent development shaped by the inherited urban structure. Over time, however, verticalization progressively expands into adjacent and less integrated neighborhoods, revealing a gradual spatial diffusion of redevelopment. Overall, the findings indicate a transition from outward urban expansion to an urban renewal model based on parcel-by-parcel replacement of existing buildings. The study demonstrates the persistent influence of inherited spatial morphology on contemporary redevelopment patterns and contributes to broader debates on the spatial determinants of urban densification in postcolonial cities.

Keywords: vertical densification; spatial configuration; urban transformation trajectory; real estate dynamics; colonial pericenter

1. Introduction

Vertical densification has become a major driver of contemporary urban transformation in response to land scarcity, demographic growth, economic pressures, and sustainability-oriented

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planning agendas (Nethercote, 2019; Piętocha et al., 2025; Teller, 2021). It is commonly promoted as a strategy to contain urban sprawl, optimize existing infrastructure, and reinforce urban centralities (UN-Habitat, 2016, pp. 36–38). However, beyond its technical and regulatory dimensions, vertical densification also reflects political choices, land-value strategies, and institutional arrangements that shape the production of urban space (Burte, 2024).

Research on urban verticalization has predominantly focused on metropolitan and global cities, where high-rise development is closely associated with real-estate financialization, gentrification, and entrepreneurial urbanism (Liu et al., 2025; López-Morales et al., 2025). Comparatively less attention has been devoted to large cities of the Global South, where vertical growth often occurs incrementally through successive demolition–reconstruction projects embedded within inherited urban fabrics (Senarathna & Hettiarachchi, 2025).

In North Africa, particularly in Algeria and Morocco, these fragmented redevelopment processes increasingly reshape colonial pericentral districts under growing real-estate pressure (Aljem & Segtan, 2025). Existing studies have documented their socio-spatial impacts, landscape transformation, and the emergence of new urban centralities (Fenchouch & Tamine, 2019; Kebir & Zeghiche, 2014, 2022; Lacheheb & Madani, 2024; Mouaziz-Bouchentouf, 2017; Rezk-Kallah et al., 2021). Nevertheless, limited attention has been paid to how inherited urban morphology influences the location, intensity, and trajectories of vertical densification, particularly through its interaction with accessibility patterns and private real-estate investment.

Urban morphology provides a useful framework for addressing this gap. Previous studies have shown that parcel configuration, street-network structure, building typologies, and property regimes influence redevelopment opportunities by either facilitating or constraining urban reinvestment (Gallagher et al., 2019; Kostourou, 2021). This perspective suggests that vertical growth should be understood not only as a response to market demand or planning regulations, but also as a process conditioned by inherited spatial configurations.

Blida offers a particularly relevant case for examining these relationships. As a large city in northern Algeria, its colonial pericenter is characterized by a highly structured urban fabric where recent densification occurs mainly through privately led demolition–reconstruction operations carried out within existing planning regulations rather than through large-scale urban renewal programs. This context provides an opportunity to investigate how inherited spatial configurations continue to shape the pace, location, and intensity of vertical redevelopment.

Drawing on building and demolition permit records, combined with urban morphological and space syntax analyses, this study examines the trajectories of vertical densification in Blida's colonial pericenter over three periods (2012, 2019, and 2024). It contributes to current debates on urban densification by demonstrating how inherited urban form, accessibility, planning regulations, and real-estate dynamics interact to structure incremental verticalization in a large city of the Global South.

2. Literature review

Urban growth trajectories are shaped by geographical conditions, institutional frameworks, and socio-economic contexts (Güneralp et al., 2020). A widely used analytical framework describes urban growth as alternating between phases of diffusion characterized by extensive, low-density expansion and coalescence, marked by infill within urbanized areas and intensification of the existing built environment. While these models explain horizontal

urban expansion, recent studies emphasize that contemporary urban transformation must also be understood through its vertical dimension, as high-rise development increasingly reshapes the morphology and functioning of cities (Soltani et al., 2025).

In Algeria, urban development has long been dominated by peripheral expansion driven by demographic growth, public housing policies, informal urbanization, and the conversion of agricultural land (Bakour & Baouni, 2015; Belguidoum & Mouaziz, 2010). More recently, however, rising land scarcity and increasing property values have encouraged a shift toward internal urban restructuring, particularly in central and pericentral districts (Fenchouch & Tamine, 2019; Kebir & Zeghiche, 2014, 2022). In these areas, vertical densification is primarily achieved through demolition–reconstruction processes, as colonial residential buildings are often perceived as economically obsolete and are therefore replaced by higher-density developments (Bachar, 2022; Chouaf & Gherzouli, 2024). This transition reinforces the role of land and property as key drivers of urban transformation and value creation (Bachar, 2022; Veschambre, 2005).

Urban morphology provides a valuable framework for understanding how inherited spatial configurations shape redevelopment trajectories. Following Conzen (1960), cities can be viewed as historical palimpsests in which the persistence of street networks, plot structures, and building patterns creates a strong morphological inertia. Consequently, redevelopment opportunities are conditioned by inherited urban form rather than determined solely by planning regulations or market demand. Plot characteristics—including size, shape, accessibility, and subdivision potential—strongly influence the feasibility of demolition, reconstruction, and vertical intensification (Bobkova et al, 2019; Kostourou, 2021; Tümtürk et al., 2024). Compact and regular plots generally offer greater redevelopment potential and tend to generate higher land values (Gallagher et al., 2019; Siksna, 1998; Vialard, 2012).

This configurational perspective is further developed by space syntax, which explains how street-network structure influences accessibility, centrality, and spatial integration, thereby affecting urban activities, investment patterns, and land values (Hillier, 1996, 1999; Hillier et al., 1993). Empirical studies consistently demonstrate that highly integrated urban spaces attract redevelopment and concentrate real-estate investment (Chiaradia et al., 2009; Law et al., 2013; Lykostratis & Giannopoulou, 2022; Xiao et al., 2016). Similarly, morphometric research shows that continuous street frontages, dense perimeter blocks, and highly integrated street networks constitute spatial assets that increase redevelopment potential (Venerandi et al., 2016). Together, these approaches suggest that vertical densification is not randomly distributed but is strongly conditioned by inherited morphological and configurational properties of the urban fabric.

3. Study context

3.1. Blida: a complementary urban hub within the Algiers metropolitan system

Blida, one of the four municipalities comprising the Greater Blida area (16,332 ha), covers 5,737 ha between the Mitidja plain and the Atlas foothills. Its population increased from 163,586 inhabitants in 2008 to 188,079 in 2019 and was projected to reach more than 211,000 inhabitants by 2023, with an urbanization rate of 93% (Centre d'Études et de Réalisations en Urbanisme de Blida, 2015; Direction de la Programmation et du Suivi Budgétaires de la Wilaya de Blida, 2019; Office Nationale des Statistiques [ONS], 2008). According to the Algerian urban hierarchy (ONS, 2011), Blida is classified as a large city, reflecting its growing

demographic and functional importance within the Algiers metropolitan system (Figure 1). Its strategic location in the fertile Mitidja plain, historically known for citrus production, has reinforced its regional role.

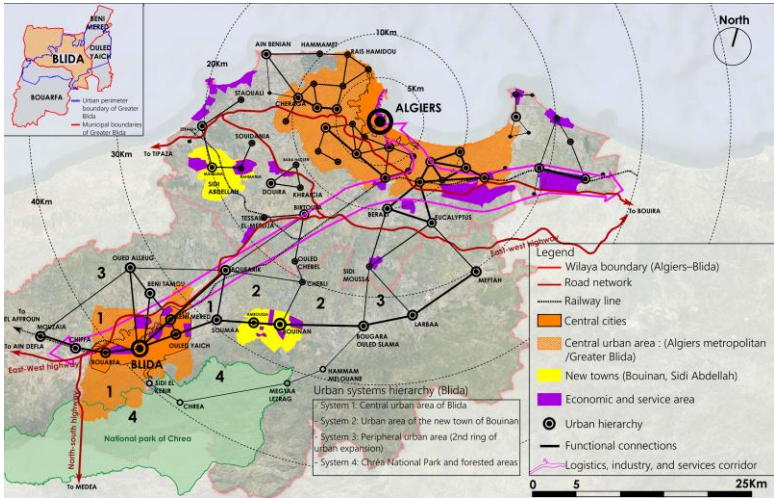


Figure 1. Blida within the urban system and territorial competitiveness of the Algiers region.

Note. Modified from *Plan directeur d'aménagement et d'urbanisme d'Alger: Rapport d'orientation et rapport de présentation* [Master plan for development and urban planning of Algiers : Orientation report and presentation report] by Parque Expo, 2016, Wilaya d'Alger, and supplemented with information on Blida.

In recent years, Blida has experienced a marked intensification of real-estate activity, particularly in the residential sector. This trend is largely driven by the saturation of the Algiers property market, where rising land prices have redirected investment toward nearby secondary cities. Although land values remain lower than in the capital, the average price of land for high-standard multi-family housing reached 198,300 DZD (€1,398.74)/m² in Algiers compared with 136,000 DZD (€959.30)/m² in Blida during the 2023–2024 biennium, according to the real-estate price index published by the General Directorate of Taxes (Direction Générale des Impôts, 2024). This price differential has reinforced Blida's attractiveness, sustaining both a steady increase in local property values and growing speculative pressure. This dynamic is further reflected in the increasing role of private developers: the national register of the Mutual Guarantee and Surety Fund for Real Estate Development (Mutual Guarantee and Surety Fund for Real Estate Development, 2024) recorded 10,818 registered real-estate developers, of which 12% were located in Algiers and Blida combined, with Blida alone accounting for 2% of the national total. Together, these indicators highlight the city's growing attractiveness for residential and mixed-use investment and the expanding contribution of private developers to the ongoing reconfiguration of Blida's urban landscape.

3.2. Blida's pericentral zone

Blida's pericentral zone surrounds the sixteenth-century historic core and was largely consolidated during the French colonial period through two successive phases of urban expansion. The first ring (1929–1940) (Figure 2A) is characterized by a low-rise residential

fabric composed mainly of pavilion-type housing, including detached houses and traditional courtyard dwellings, organized along a hierarchical radial street network connected to the historic center. This urban fabric resulted from an extensive subdivision process, with 46 residential subdivisions developed between 1923 and 1962 (Deluz-La Bruyère, 1988, p. 63). Its predominance is confirmed by the Blida Master Plan, which indicates that individual housing represented 86% of the city's residential stock, and occupied 47.88% of the colonial pericentral area (Centre d'Études et de Réalisations en Urbanisme de Blida, 2010). The second ring (1940–1960) reflects the planning rationalities of colonial urbanism, grounded in principles of monofunctional zoning, with a greater concentration of collective housing and public facilities. Today, this inherited residential matrix is undergoing rapid transformation through demolition–reconstruction processes that progressively replace low-rise residential buildings with high-rise mixed-use developments (Figure 2B). Similar dynamics have been observed in other Algerian cities, such as Annaba (Chebini et al., 2023), where redevelopment is driven by both licensed private developers and individual property owners operating within formal and informal frameworks.



Figure 2. Urban structure and transformation dynamics in Blida (2024). Panel A: Homogeneous zones of Blida. Panel B: High-rise buildings (HRBs) and demolition processes in Blida's pericenter (photographs taken in April 2024). *Note.* Panel A: Based on *Plan directeur d'aménagement et d'urbanisme de Blida* [Blida Master Plan for Development and Urban Planning], by Centre d'Études et de Réalisations en Urbanisme de Blida, 2015 (<https://fr.scribd.com/document/790436033/Livre-4-REGLEMENT>). In the public domain.

4. Methodology

This study investigates trajectories of vertical densification in Blida's colonial pericentral area using building and demolition permits as primary indicators of urban transformation. Permit data are widely recognized in urban studies for their ability to reveal the mechanisms underlying the production of urban space, anticipate housing market trends, assess the socio-ecological impacts of urbanization, and document changes in planning practices and urban morphology (Alkay et al., 2019; Delgado Ramos, 2019; Lavastre, 2006).

A systematic review of the registers maintained by the Urban Planning Department of the Blida Municipal People's Council was conducted for all permits issued between 2019 and July 2024. The database comprised 373 building permits and 264 demolition permits. Analysis focused on: (i) annual trends in permit issuance; (ii) project characteristics, including building type, parcel size, and building height, with particular emphasis on HRBs; and (iii) the spatial distribution of urban transformation within the pericentral area.

Definitions of HRBs vary across regulatory contexts, reflecting differing safety regulations and urban design frameworks. A building is classified as high-rise when it exceeds 50 m in France, 18 m in Canada (National Building Code, NBC), and 23 m in the United States (International Building Code, IBC). In Algeria, Decree No. 76-35 of 20 February 1976 defines HRBs as those exceeding 50 m for residential use and 28 m for other building types. Because these thresholds primarily serve fire-safety regulations rather than urban morphological analysis, this study adopts a threshold of 17 m (five stories). Within Blida's predominantly low-rise urban fabric, buildings exceeding this height generate a marked spatial and visual discontinuity while corresponding to the maximum height permitted along tertiary roads under the Blida Master Plan (Centre d'Études et de Réalisations en Urbanisme de Blida, 2015).

Since permit registers document permit issuance but not project implementation, the database was complemented by field surveys and satellite image interpretation. Site visits enabled verification of the implementation status of each project. Of the 118 permits issued for buildings ≥ 17 m, 91 had been completed, 11 were under construction, and 16 had been abandoned, resulting in an implementation rate of 86% for completed and ongoing projects. Among the 162 demolition permits, 120 had been implemented and 42 had not, corresponding to an implementation rate of 74%. Of the completed demolitions, 54 plots subsequently received building permits for new constructions.

To extend the analysis beyond the permit records, a diachronic inventory of HRBs was established using a GeoEye-1 orthoimage acquired on 08 January 2012 (50 cm spatial resolution) together with historical Google Earth imagery from December 2019 and March 2024. The GeoEye image served as the reference dataset for orthorectifying the Google Earth imagery in ERDAS IMAGINE, ensuring spatial consistency across the three observation dates. HRBs were subsequently identified and georeferenced for 2012, 2019, and 2024, resulting in an inventory of 200 buildings used to analyze long-term trajectories of vertical development.

Spatial analysis was conducted at the parcel scale to evaluate the location patterns of HRBs. Two indicators were calculated: (i) the average nearest-neighbor distance between parcels containing HRBs to measure clustering and dispersion, and (ii) the distance from each parcel to the centroid of the historic core, used to assess the influence of centrality on redevelopment dynamics and real-estate value (Law et al., 2013).

The relationship between HRB distribution and street-network configuration was finally examined using Space Syntax. Global integration (HH) and connectivity were calculated from an

axial map generated in Depthmap©10. HRBs were linked to their nearest axial lines using spatial joins in ArcGIS 10.8. The relationships between HRB density and syntactic variables were assessed using Spearman's rank correlation coefficients and ordinary least squares (OLS) regression.

5. Results

5.1. Toward a shift in construction preferences

An analysis of building and demolition permits issued by Blida's Urban Planning Department between 2019 and July 2024 reveals major shifts in the city's real-estate dynamics. Individual housing remains the dominant typology, accounting for approximately 60% of all building permits, while 34% concern high-end collective housing. The remaining 6% correspond to private service facilities, shopping centers, schools, hotels, and clinics, reflecting the progressive diversification of urban functions.

Demolition permits remained relatively stable between 2019 and 2022 (around 50 permits annually) before declining sharply in 2023 (–42%), while building permits followed a similar trajectory, decreasing from 79 permits in 2019 to 32 in 2023 before recovering slightly to 55 in 2024 (Figure 3A). This decline reflects both economic and regulatory factors. Persistent inflationary pressures and investment uncertainty reduced construction activity following the economic recession triggered by the COVID-19 pandemic, while the construction sector's growth slowed from 4% in 2022 to 3.7% in 2023 (Bank of Algeria, 2024, pp. 3–22). At the same time, Executive Decree No. 22–55 (Direction et Redaction Secretariat General du Gouvernement, 2022) introduced stricter permit requirements and financial penalties for non-compliant developments, contributing to longer administrative procedures and fewer project approvals.

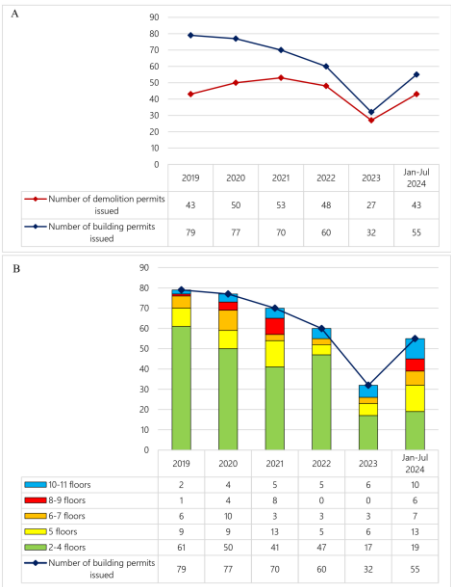


Figure 3. Building permit dynamics and vertical development trends in Blida (2019–July 2024). Panel A: Temporal trends in approved building and demolition permits. Panel B: Maximum authorized building heights for residential and service infrastructure projects.

Beyond these short-term fluctuations, permit data reveal a structural shift in construction preferences. Between 2019 and 2024, permits for low-rise individual housing (2–4 stories) declined from 61 to 19, whereas permits for high-rise residential developments (5–11 stories) doubled from 18 to 36 (Figure 3B). These trends indicate a progressive transition from the traditional single-family housing model toward higher-density residential development.

This transformation is consistent with the planning framework established by the Blida Master Plan, which increased permissible building heights along the city’s main corridors. The regulations authorize buildings of up to 10 stories on major boulevards (60% FAR with an additional 10% allowance for corner plots), nine stories on primary roads, seven on secondary roads, and five on tertiary roads (Centre d’Études et de Réalisations en Urbanisme de Blida, 2015; Sahraoui & Bada, 2021). However, as noted by Sahraoui and Bada (2021), this regulatory framework has not been accompanied by an integrated urban development strategy. The relaxation of height restrictions has facilitated vertical densification but has also encouraged speculative redevelopment driven by private developers and landowners, often at the expense of urban quality and spatial coherence.

5.2. *Pericentral areas as epicenters of demolition-reconstruction activities*

Analysis of building and demolition permits reveals a highly polarized pattern of urban transformation concentrated in Blida's pericentral areas, which have become the principal loci of private-led redevelopment (Figure 4). The first pericentral ring records 136 building permits, predominantly for high-end residential projects exceeding 17 m (five stories), together with 102 demolition permits, reflecting an active cycle of demolition–reconstruction in which single-family houses are progressively replaced by high-rise residential and mixed-use developments. The second ring exhibits a similar, although less intense, trajectory, characterized by moderate building heights averaging four stories and a more gradual process of densification.

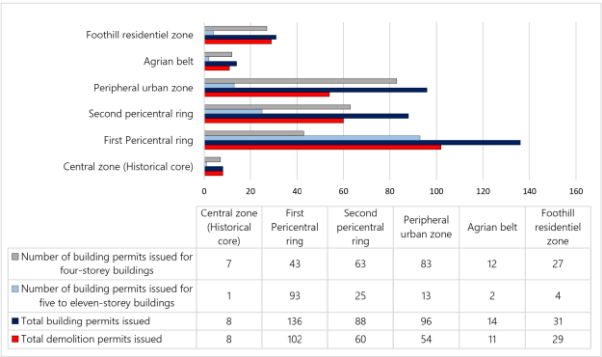


Figure 4. Spatial distribution of approved building and demolition permit applications.

By contrast, the historic core (approximately 70 ha) remains comparatively stable because its compact urban fabric, heritage value, and planning regulations restrict large-scale redevelopment opportunities (Sahraoui & Bada, 2021). Peripheral areas display a different development pattern, dominated by low-rise individual housing (up to four stories). The agrarian belt recorded only 14 permits, mainly for industrial uses, whereas the piedmont

zone registered 31 permits for single-family housing, indicating limited outward expansion driven primarily by land availability and demographic growth.

5.3. Clustering Analysis and Spatial Dynamics of HRBs

A spatial analysis was conducted to examine the distribution of HRBs (HRBs, ≥ 17 m) completed or planned between 2012 and July 2024. Using ArcGIS 10.8, Euclidean distances were calculated between each HRB and its nearest neighbor and between each HRB and the centroid of the historic core. To minimize bias associated with parcel geometry, buildings were represented by points located along the parcel frontage facing the principal public street, defined according to the hierarchy established in the 2015 Master Plan (Figure 5B). In cases where roads were of equal importance, the façade with the greatest linear frontage along the public space was selected.

The spatial distribution of HRBs exhibits a predominantly linear pattern aligned with Blida's main radial arteries connecting the historic core to the expanding urban fringe. The heatmap (Figure 5A) reveals a distinctive “glove-finger” morphology in which discontinuous clusters of HRBs follow these historic corridors. Between 2019 and 2024, new concentrations emerged along Kritli Mokhtar Boulevard, Mustapha Ben Boulaid Avenue, and around the intersections of Larbi Tebessi Boulevard with Belkacem El Ouzri Street, Palestine Street, and Mustapha Ben Boulaid Avenue, confirming the continued role of these major axes in structuring vertical urban growth.



Figure 5. Spatial patterns of high-rise development and demolition–reconstruction processes in Blida. Panel A: HRBs exceeding 17 meters completed or under construction with authorized building permits. Panel B: Parcel layout showing sites of demolition–reconstruction for HRBs (Dusseaux Subdivision, 2012). *Note.* Panel B: Based on GeoEye-1 orthoimage (2012). Centre d’Études et de Réalisations en Urbanisme de Blida, Blida.

Parcel statistics indicate a progressive reduction in the size of plots accommodating HRBs. Mean parcel size decreased from 1,412.4 m² in 2012 to 413.9 m² in 2024, while minimum and maximum parcel sizes declined from 207.5 to 119.4 m² and from 14,537.8 to 2,058.4 m², respectively, indicating that recent vertical development increasingly occurs on smaller parcels.

Euclidean distance results indicate intensification of pericentral densification between 2012 and 2024. Boxplots of inter-building distances (Figure 6A) show a steady decline in median

spacing, which fell below 100 m by 2024. In 2012, building distribution exhibited dispersion, reflecting sporadic and weakly coordinated developments largely shaped by opportunistic land availability. From 2019 onwards, the intensification of demolition–reconstruction operations contributed to a growing concentration of the built environment, further accelerated by 2024 as new developments adhered to a logic of land-use optimization, leading to increased density and a gradual homogenization of the urban fabric.

Concurrently, distances from the historic core (Figure 6B) reveal a gradual outward shift of vertical growth. Between 2012 and 2019, high-rise development remained concentrated within the first pericentral ring, reflecting consolidation of the urban fabric surrounding the historic core. However, between 2019 and 2024, both mean and median distances increased, indicating a shift of high-rise development toward the second ring. This centrifugal expansion follows Mohamed Boudhief Boulevard, which encircles the first pericentral ring and serves as a major structuring axis for the expansion of HRBs.

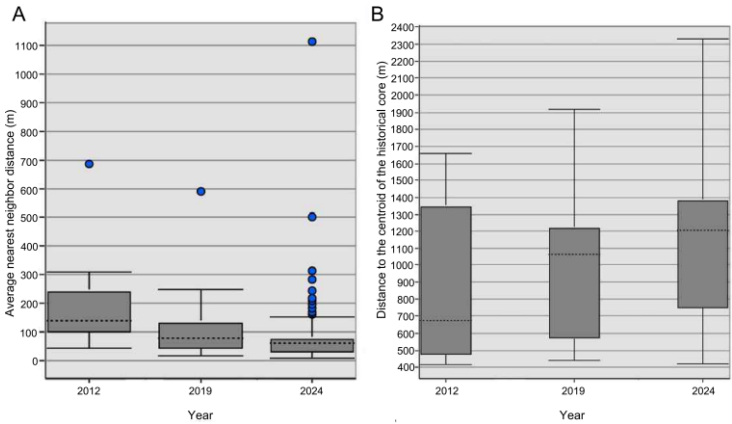


Figure 6. Temporal evolution of HRB dispersion (2012–2024) based on: Panel A: Average nearest neighbor distance. Panel B: Distance to the centroid of the historical core.

5.4. Correlation between verticalization and the topological characteristics of the street network

An axial map generated from the Blida Master Plan (Centre d'Études et de Réalisations en Urbanisme de Blida, 2015) and updated in 2024 was overlaid with a heatmap showing the spatial concentration of HRBs (Figure 7). The street network comprises 2,179 axial lines covering 23.77 km², with an average connectivity of 3.23. Global integration (HH) ranges from 0.34 to 1.36, with a mean value of 0.80.

The analysis reveals a hierarchical spatial structure extending from a highly integrated historic core (mean global integration = 1.03; connectivity = 5.43) toward progressively more segregated peripheral areas (Table 1). The first pericentral ring exhibits the highest integration values (max = 1.36; mean = 0.93) and relatively high connectivity (3.87), confirming its role as the principal interface between the historic core and the expanding urban fabric. By contrast, the second pericentral ring and outer urban sectors display moderate integration (mean = 0.87), whereas the agrarian belt and foothill zone remain weakly integrated (mean = 0.81 and 0.61, respectively), reflecting their greater spatial isolation.

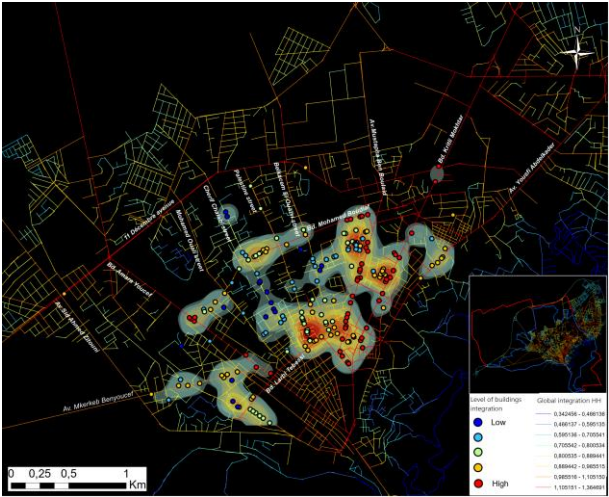


Figure 7. Axial map overlaid on a heat map illustrating concentration and spatial integration of HRBs.

Table 1. Comparison of global integration (HH) and connectivity indices across homogeneous urban zones

Homogeneous zone	Global integration value HH			Connectivity value		
	Min	Mean	Max	Min	Mean	Max
Central zone (historical core)	0.85	1.03	1.30	1	5.43	44
First pericentral ring	0.48	0.93	1.36	1	3.87	44
Second pericentral ring	0.43	0.87	1.36	1	3.50	44
Peripheral urban zone	0.60	0.87	1.36	1	3.86	42
Agrarian belt	0.59	0.81	1.02	1	3	6
Foothill residential zone	0.28	0.61	1.16	1	2.53	9

At the level of Blida's pericentral area (first and second rings), the spatial analysis of HRBs reveals a strong concentration in zones with high street network integration: 54% of the surveyed HRBs are located in sectors with integration values exceeding 1.07 (Table 2). This concentration reflects a clear preference for well-connected central locations, where accessibility justifies vertical densification. Zones with medium integration (values between 0.93 and 1.07) host 74 HRBs, representing 37% of the total, indicating that even intermediate levels of accessibility maintain significant attractiveness for high-rise projects. In contrast, only 18 units (9%) are situated in areas with low integration (value < 0.93).

Table 2. Distribution of HRBs by global Integration and connectivity levels

	Global integration HH		Connectivity	
	Score	No. of HRBs	Score	No. of HRBs
High	HH ≥ 1.07	108	Connect ≥ 17	55
Moderate	0.93 ≤ HH < 1.07	74	5 ≤ Connect < 17	114
Low	HH < 0.93	18	Connect < 5	31

The diachronic analysis reveals a positive and statistically significant relationship between street-network integration and HRB density, although its strength declines over time. In 2012,

the Spearman correlation coefficient reached $\rho = 0.86$ ($p = 0.0007$), while the OLS model explained approximately 64% of the variance in HRB density ($R^2 = 0.63$). The estimated slope (5.20; 95% CI: 2.25–8.15) indicates that each additional unit of global integration is associated with an increase of two to eight HRBs. By 2019, the relationship remained strong ($\rho = 0.823$, $p < 0.001$; $R^2 = 0.522$), although HRBs had begun to spread into moderately integrated areas. In 2024, the correlation weakened ($\rho = 0.659$, $p < 0.001$), with the regression explaining only 39.8% of the variance ($R^2 = 0.398$). This decline reflects the progressive spatial diffusion of HRBs beyond the most integrated streets into less integrated urban areas (Figure 8).

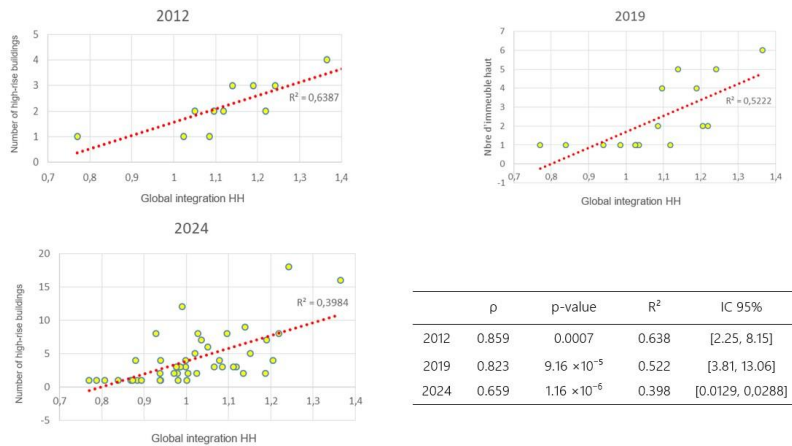


Figure 8. Correlation between global street network integration and HRBs density.

6. Discussion

The results indicate that vertical densification in Blida’s colonial pericenter does not follow a homogeneous process nor a strictly planned dynamic. Rather, it unfolds along an incremental trajectory, shaped by inherited spatial structures and the contemporary regulatory framework. The evolution of building and demolition permits illustrates this trend: the gradual reduction of the gap between these authorizations up to mid-2024 reflects a shift from an expansion-oriented model toward an urban renewal logic based on the substitution of existing buildings. However, unlike large-scale urban renewal projects observed in global metropolises, verticalization in Blida advances through the juxtaposition of discrete interventions, predominantly driven by private actors and embedded within a historically established urban fabric. This pattern confirms that, in large cities of the Global South, vertical densification often takes ordinary, fragmented, and spatially selective forms (Senarathna & Hettiarachchi, 2025), rather than spectacular ones.

The concentration of demolition–reconstruction projects within the pericentral area (60% of building permits and 61% of demolition permits) highlights the strategic role of these intermediate urban spaces in contemporary densification trajectories. This spatial polarization reflects a renewed interest in central sectors, interpreted as a “return to the city.” In Blida, however, it reflects less a structured public regeneration policy than an opportunistic valorization of inherited spaces, facilitated by high accessibility and a relatively permissive regulatory framework. The colonial pericenter, characterized by high spatial integration,

emerges as the primary locus of transformation. Similar patterns have been observed in Annaba in Algeria, where the most integrated colonial pericentral fabrics (average global integration of 0.44) also attracted the most intense real estate investments (Kebir & Zeghiche, 2022; Laouar et al., 2019). This attractiveness is closely linked to the legacy of the colonial street network, structured around radial axes and belt boulevards that continue to channel flows and investment strategies. The results therefore confirm that verticalization does not diffuse isotropically but preferentially aligns along historically integrated corridors, producing linear and discontinuous growth rather than a homogeneous front of densification.

This reorientation of residential development toward already urbanized areas is consistent with a broader logic of inner-city land valorization and urban containment. In Blida, where urban expansion continues to threaten the fertile agricultural lands of the Mitidja Plain, vertical densification represents a potential mechanism for reducing land consumption. However, the benefits associated with this form of land-use efficiency are accompanied by new challenges related to the intensification of residential densities within an urban fabric historically designed for lower occupancy levels. The capacity of infrastructure, public facilities, mobility networks, and public spaces to accommodate this intensification therefore becomes a key issue for the long-term sustainability of these densification trajectories.

The clustering analysis further demonstrates that verticalization develops through the successive consolidation of emerging redevelopment poles rather than random spatial dispersion. The progressive reduction in inter-building distances reflects the accumulation of projects in areas already undergoing transformation, revealing ripple effects and a cumulative logic typical of incremental densification processes. This trajectory is accompanied by a structural shift in the land parcels mobilized. While the initial phases of verticalization relied primarily on large available plots, the recent period is characterized by the increasing use of smaller, more homogeneous parcels drawn from the colonial low-density housing fabric, typically ranging from 200 to 500 m² (Sahraoui, 2006). Verticalization thus advances through parcel-by-parcel replacement, via demolition–reconstruction operations at the individual lot scale (Kostourou, 2021), reflecting an adaptation of the real estate market to inherited morphological constraints.

Beyond its morphological effects, this transformation is gradually redefining residential environments within the colonial pericenter. The gradual transition from a fabric dominated by detached housing to higher-density collective residential forms reflects changing modes of production and use of residential space. Although this study does not directly examine socio-demographic change or residential mobility, these processes are likely to influence the social composition and residential practices of affected neighborhoods. Assessing these social consequences constitutes an important direction for future research on contemporary urban transformation in Algerian cities.

The diachronic trajectory observed (2012–2019–2024) goes beyond a mere statistical evolution of the correlation between street network integration and HRB density; it signals a genuine regime shift in urban space production. The evolution of the spatial system follows a morphogenetic logic, in the sense of Caniggia and Maffei (2001), where densification occurs parcel by parcel. In its initial phase, built development remains closely aligned with the most integrated street structure. In 2012, the observed correlation ($\rho = 0.86$) illustrates this stage, where the rectilinear and continuous axes of the colonial fabric act as catalysts for the first vertical clusters. This finding aligns with the work of Venerandi et al. (2017) in London, showing that vertical densification begins along the most integrated spatial structures before spreading

more widely. As Hillier (1996, p. 125) emphasized, “the fundamental element of land use is neither the zone nor even the block, but the line”: morphological transformations propagate along street alignments according to their degree of integration and connectivity.

The gradual decline in correlation coefficients observed in 2019 and 2024 does not signal a diminished role of the street network; rather, it reflects the verticalization process entering a phase of maturation. As the most integrated segments reach a morphological saturation threshold, vertical densification begins to extend into less central areas of the spatial system. Consequently, the initially strong association between integration and HRB density weakens, giving way to a more diffuse pattern in which the structuring influence of major axes is gradually supplanted by capillary propagation along secondary streets, a process made possible by the orthogonal street grid characteristic of the 19th-century colonial fabric. Proximity indicators corroborate this transition: the continuous reduction in inter-building distances points to a densification of building placement and the concentration of projects within intermediate fabrics. Thus, vertical densification becomes the product of a cumulative logic of micro-transformations.

The cumulative effects of this trajectory are particularly visible in the urban landscape. Since verticalization proceeds primarily through a succession of parcel-scale redevelopment operations rather than coordinated large-scale renewal projects, it generates a gradual yet spatially fragmented recomposition of the built environment. This dynamic produces a landscape characterized by the coexistence of contrasting architectural forms, building heights, and periods of construction, reflecting the superimposition of successive phases of urban production. The colonial pericenter is thus evolving toward a hybrid configuration in which inherited morphological structures coexist with taller contemporary residential forms. This finding is consistent with the observations of Rezk-Kallah et al. (2021) in Oran, who highlighted how verticalization processes contribute to the transformation of the urban landscape and the emergence of new morphological configurations within historic urban fabrics. In this context, the hybridization observed in Blida extends beyond the physical transformation of the built environment; it also contributes to a gradual redefinition of the area’s landscape identity and highlights the growing tensions between densification objectives, land valorization, and the preservation of the urban qualities associated with historic urban fabrics.

7. Conclusion

This study contributes to the growing body of research on urban verticalization by demonstrating how inherited morphological structures influence contemporary densification trajectories. Combining a diachronic inventory of HRBs derived from building and demolition permits with space syntax indicators provides a longitudinal perspective on the transformation of Blida’s colonial pericenter. This integrated approach relates building renewal processes to the configurational properties of urban space and identifies the spatial mechanisms underlying vertical growth.

The findings show that high-rise development concentrates in the most integrated and accessible sectors of the urban fabric. Rather than resulting from comprehensive redevelopment schemes, verticalization proceeds through incremental, parcel-by-parcel demolition–reconstruction processes, producing a gradual reconfiguration of the colonial pericenter. These trajectories demonstrate that inherited urban morphology, planning

regulations, and real-estate dynamics jointly structure contemporary urban transformation, highlighting the enduring influence of historical spatial configurations on urban production.

The present analysis identifies robust spatial associations between verticalization and street-network configuration but does not establish direct causal relationships. Future research should therefore investigate the influence of complementary factors, including land-market mechanisms, public policies, transport infrastructure, and the strategies of public and private actors, in order to better explain the drivers of vertical densification.

Furthermore, the methodological framework developed in this study, combining permit data, historical imagery, and space syntax, provides a robust basis for analyzing the spatio-temporal trajectories of urban verticalization at the urban scale. Complementary research could incorporate additional geospatial approaches to further enrich the analysis of urban transformation processes. In particular, the integration of three-dimensional urban data, advanced remote sensing techniques, and multi-source approaches could offer valuable opportunities for improving the characterization of vertical growth dynamics. The implementation of such approaches, however, remains constrained by issues related to data availability, temporal consistency, spatial comparability, and access to reliable urban information.

Beyond the case of Blida, this research opens avenues for comparative investigations of verticalization processes in postcolonial urban pericenters. Future studies could further explore the morphological mechanisms underlying the renewal processes identified in this study. In contexts where urban transformation occurs primarily through parcel-by-parcel demolition and reconstruction, the integration of typo-morphological and morphometric approaches would provide a particularly relevant framework for examining building replacement dynamics and urban transformation trajectories. Such a perspective would help refine our understanding of the role played by inherited morphological structures in shaping verticalization processes and the production of contemporary urban forms. More broadly, these developments would contribute to advancing knowledge on the interactions between urban morphology, accessibility, and building renewal, while providing an empirical basis for urban regeneration policies that seek to reconcile densification, morphological continuity, and spatial coherence.

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