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Research on the historical spatial characteristics and conservation strategies of colonial cities in Asia and Africa: a case study of 21 typical cities

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Abstract

Colonial cities in Asia and Africa, developed under the dual influence of native and sovereign cultures during the colonial era, exhibit unique urban morphological characteristics and reflect the planning ideologies of diverse cultures. Thus, the morphological study of colonial cities in Asia and Africa is crucial for understanding and identifying the historical and cultural value of these cities, which in turn enables the formulation of precise conservation strategies. In light of this, the study develops an urban morphological analysis methodology comprising "Colonial Background Analysis—Morphological Characteristics Analysis—Driving Factor Extraction" based on the Conzenian Approach, which is used to examine the morphology of 21 typical colonial cities in Asia and Africa across various colonial periods. As a result, "Dual-City" emerges as the core spatial characteristic of colonial cities in Asia and Africa, reflecting the morphological differences in road layouts, urban fabric, and urban cores between native and European zones. Additionally, as native settlement sizes, social structures, and cultural identities differ between cities, three major spatial patterns of the "Dual-City" model can be identified: separated, mediated, and integrated spatial patterns, resulting from the varied planning approaches applied by colonizers. Furthermore, suggestions for the conservation of colonial heritage are proposed based on the driving factors analysis from the morphological study.

Keywords Colonial city, Morphology, Spatial pattern, Conzenian approach, Heritage conservation

Introduction

The modern colonial city is an important type of human settlement, its historical urban form serves as both a material carrier of European modern urban planning ideas after the Renaissance and a spatial foundation for local urban development. The significance of colonial cities is widely recognized, as evidenced by

the fact that 98 world heritage sites are related to this settlement type, accounting for approximately 10% of the total number of cultural heritage sites designated by UNESCO. These cities are widely distributed across the Asia–Pacific, Africa, and the Americas, thus, their urban forms differ by region due to environmental and cultural variations. The Asian and African colonial cities, compared to those in the Americas and Australia, had large populations and large-scale native settlements before the arrival of European explorers. Consequently, the colonial cities in Asia and Africa were planned with the consideration of cultural separation and preservation rather than thorough reconstruction, showcasing diverse civilizational elements and cultural imprints [1], which emphasizes the significance

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of urban form in representing the multicultural value of Asian and African colonial cities. However, with the rapid urban expansion and cultural decolonization process in Asia and Africa, some colonial settlement heritages are facing inappropriate urban alternations and calling for urgent conservation [2]. Thus, the study of urban forms of Asian and African colonial cities has been the key to assist the better preservation of this special settlement heritage and its related planning wisdom through the morphological understanding.

At present, there are plentiful urban form studies, with major academic schools of Conzen of German–British origin [3], Muratori of Italian origin [4] and Versailles of French origin [5], core theoretical framework about Urban Morphology and Architectural Typology, and well-known scholars as Caniggia, Maffei, Maretto, Petruccioli, Panerai, Castex, DePaule, Whitehand [5–9]. In addition, there are also the works of Moudon, Kropf, Samuels, and Levy [10–13] in the study of Typo-morphology. The common grounds of these studies include the consensus that the city can be read and analyzed via the medium of its physical form [14]. Moreover, the relevant studies on colonial cities are comprehensive and in-depth, mainly focusing on urban planning and development [15, 16], social segregation [17, 18], and heritage conservation [19, 20]. However, current studies are relatively rare in researching the urban form of modern Asian and African colonial cities, particularly in revealing the different spatial pattern types formed by native cultures and various suzerains under distinct colonial backgrounds.

Based on the Conzenian approach, this research focuses on the morphological analysis of 21 typical Asian and African colonial cities, which vary in morphologies formed by different suzerains under their unique development backgrounds, and cover all the colonial phases. This is done under the morphological analysis framework of "Colonial Background Analysis—Morphological Characteristics Analysis—Driving Factor Extraction", which purposively reveals the factors that influenced the formation of these colonial cities under multicultural convergence. Thus, suggestions for morphological conservation of these cities could be promoted following the morphological and factor analysis. Moreover, a city database, containing comprehensive geographical information about the historical and current spatial patterns and morphological elements of roads and buildings for each city, is constructed with reference to online digital libraries, open map collections, and OSM (OpenStreetMap).

Methods

Theoretical background of the Conzenian approach

Conzen established the fundamental framework for the study of urban morphology, proposing important concepts of "morphological period", "morphological regions" and "morphology frame", emphasizing that the forms are particularly the aggregation of urban elements to be analyzed at three levels: plan unit, building fabric, and land use. Among these, the plan unit and building fabric are the most stable, typically comprising the street system, plot pattern, and building as urban spatial pattern [3]. Even when the built environment changes, the urban spatial pattern can still exist and be read structurally as a spatial language, recognizable through the road network structure and building fabric [21]. This semantic difference in urban spatial patterns can reflect the functions of these forms and the reasons for their generation. In light of this, urban spatial pattern is currently an important morphological research subject of Conzenian approach to categorize urban forms and reflect the morphological characteristics of historical evolution [22].

The Conzenian approach has not only been applied to the study of British cities [23] and American cities [24], but has also extended to Asian cities [25] and African cities [26]. These studies vary in research scale, ranging from regions, towns, and villages to urban blocks, but all aim to reveal the social and economic forces that affect urban form through the division of urban spatial patterns. However, the Conzenian approach, which is often applied to the study of morphology shaped by one or similar cultures, has not been extensively applied to the study of colonial city forms. In light of this, there is an urgent need for a revised urban spatial pattern research framework, based on the Conzenian approach, that can reveal the unique urban forms of colonial cities shaped by both indigenous influences and sovereign powers, and facilitate the conservation of Asian and African colonial cities.

The research framework for colonial city morphology

Based on the Conzenian approach, this research proposes a framework of "Colonial Background Analysis—Morphological Characteristics Analysis—Driving Factor Extraction" to study the historical spatial characteristics of colonial cities in Asia and Africa (Fig. 1). Firstly, the colonial phases and pre-colonial settlement sizes are discussed to analyze the urban planning and social management preferences of suzerains for their colonies. Then, the spatial patterns of colonial

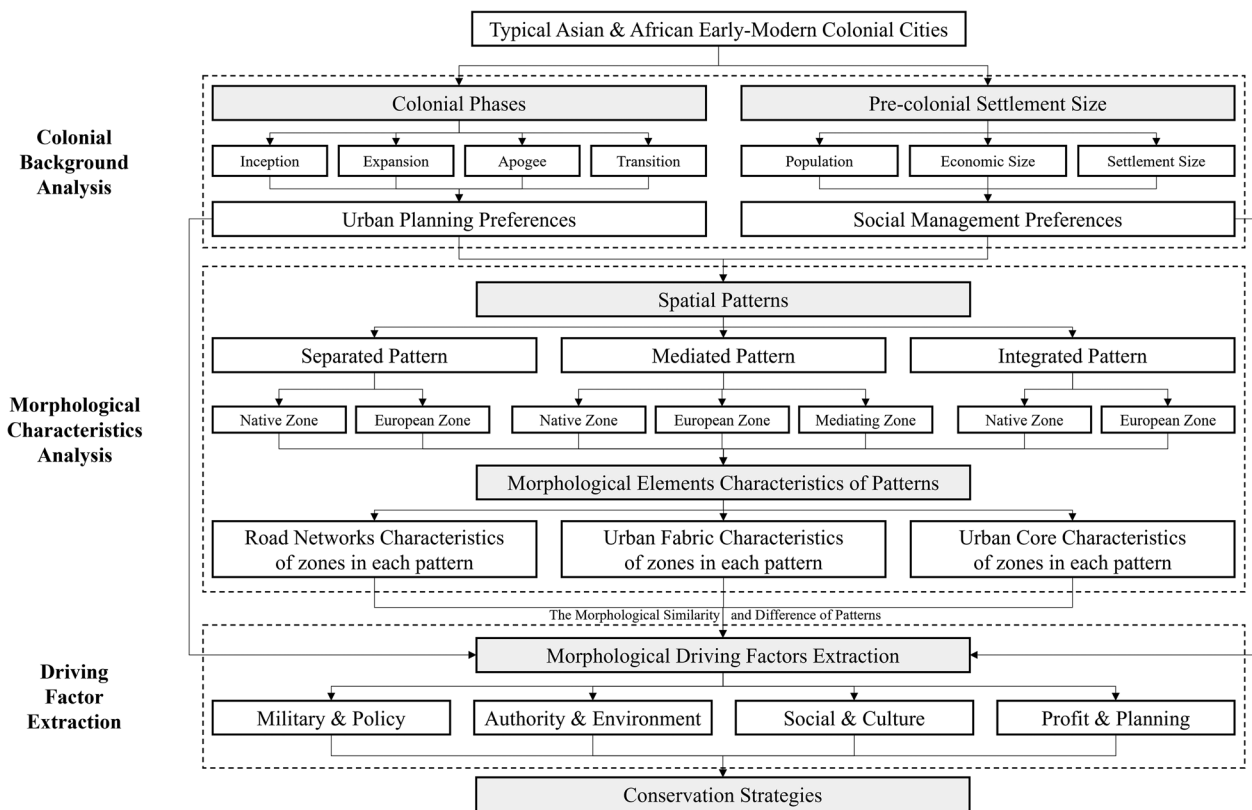


Fig. 1 Research framework

cities are classified according to the morphological and social differences between zones. The morphological elements of each pattern are explored and discussed from three aspects: road network, urban fabric, and urban core, revealing the major morphological characteristics at different levels. With the analysis of colonial background and morphological characteristics, the driving factors can be extracted by examining the relationship between urban patterns and their historical context. At last, conservation strategies are given according to the morphological research results.

Colonial background and subjects

Depicting the temporal and spatial evolution of global world cultural heritage is the basis of heritage recognition and protection [27]. Asian and African colonial cities experienced four colonialism periods of Western Europe (Commercial Capitalism, Laissez-faire Capitalism, Imperialism Period) and four colonial urban development phases (Inception, Expansion, Apogee, and Transition Phases), which can reflect the expansion routes of European colonies. Thus, the development modes of these colonial cities differ significantly due to the development periods and the differences in

native and suzerain preference for city allocation and planning.

The overview of colonial urban development in Asia and Africa

The colonial urban history in Asia and Africa can be divided into four phases of inception, expansion, apogee and transition, each reflecting the distinct allocation and urban planning preferences of different European suzerains in varied developing stage (Fig. 2): (1) Inception (mid-fifteenth to end of sixteenth century). During this time, most colonial cities were established by the Portuguese along the coast, primarily serving as nautical supply points, trade transit hubs, or missionary strongholds. Urban development during this phase was slow, small-scale, and more temporary. The cities of this time reflected medieval styles and included defensive facilities; (2) Expansion (seventeenth and eighteenth centuries). Expansion became the major theme during this phase, with both coastal and inland colonial cities established to meet the needs of chartered companies and merchants expanding their lands through global trading. Colonial cities were planned and expanded with geometric urban patterns under classical rational planning principles; (3) Apogee (nineteenth century). Following the Industrial

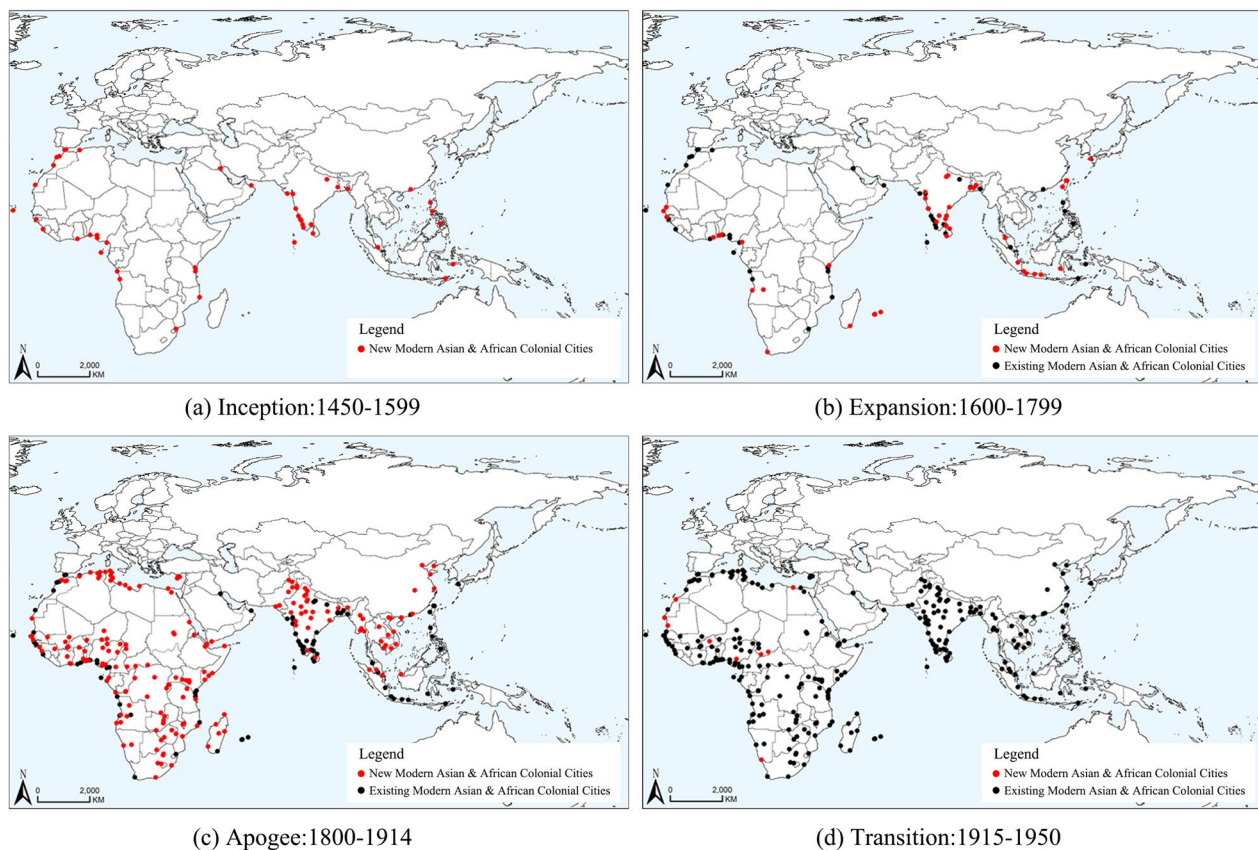


Fig. 2 The distribution of Asian and African colonial cities by phases

Revolution, colonies experienced rapid development, and more colonial cities were established. During this time, particularly inland cities grew in number due to rail construction and mining activities, showcasing neo-classical styles; (4) Transition (early twentieth century onwards). Modern planning thoughts and native cultural revolutions began to blend. Colonial cities, influenced by modern planning theories, adopted concepts of planning legislation and old city preservation.

Typical cities selection

The colonial history of Asia and Africa began in 1415 with the Portuguese occupation of the Ceuta region of North Africa, and ended with the attainment of independence by the Asian and African colonies after World War II. The Asian and African colonial cities are numerous in number and widely distributed, with a common base of colonial influence, as well as significant geographic and cultural individuality. This study selects 21 typical Asian and African colonial cities based on the *World Heritage List* and urban development status (Table 1, Fig. 3). These cities, located on major colonial

routes between Europe and the colonies, are either colonial cities listed in the World Cultural Heritage list or colonial capitals and major commercial centers preserved by national heritage departments. They have completed planning programs, better planning implementation, and morphological preservation, representing distinctive samples of the different stages of the evolution of colonial urban morphology in Asia and Africa.

Morphological analysis

Throughout the spatial evolution of typical colonial cities in Asia and Africa, due to differences in native settlement size, population distribution and culture, a dualistic spatial pattern has prevailed in the cities, with spatial opposition and differentiated construction occurring between the native and European zones of the city, also known as the "Dual City" model [29, 30]. By analyzing spatial patterns and morphological elements, this model can be divided into three urban pattern types, reflecting the different planning philosophies of suzerains from various cultural backgrounds for different colonies. This phase or

Table 1 Overview of typical colonial cities in Asia and Africa

Number	Suzerain	City	Country	Period	Status
1	Britain	Accra	Ghana	1673–1957	World Heritage
2	Britain	George Town	Malaysia	1786–1957	Colonial Capital, World Heritage
3	France	Pondicherry	India	1674–1962	Colonial Capital
4	Britain	Kolkata	India	1698–1947	Colonial Capital
5	Britain	Mumbai	India	1668–1947	Colonial Capital, Major Commercial Port, World Heritage
6	Britain	Shanghai	China	1845–1943	Major Commercial Port
7	Britain	Yangon	Myanmar	1852–1948	Colonial Capital
8	France	Hanoi	Viet Nam	1873–1955	Colonial Capital, National Capital, World Heritage
9	France	Tunis	Tunisia	1881–1956	National Capital, World Heritage
10	France	Algiers	Algeria	1830–1962	Colonial Capital, National Capital, World Heritage
11	France	Dakar	Senegal	1857–1960	Colonial Capital, National Capital, World Heritage
12	France	Pointe-Noire	Congo	1883–1960	Major Commercial Port
13	Germany	Dar es Salaam	Tanzania	1887–1916	Major Commercial Port
14	Netherlands	Jakarta	Indonesia	1619–1942	Colonial Capital, National Capital
15	Britain	Delhi	India	1858–1947	Colonial Capital, National Capital, World Heritage
16	France	Rabat	Morocco	1912–1956	Colonial Capital, National Capital, World Heritage
17	France	Casablanca	Morocco	1906–1956	Major Commercial Port
18	France	Fez	Morocco	1912–1956	World Heritage
19	France	Meknes	Morocco	1912–1956	World Heritage
20	Italy	Tripoli	Libya	1911–1943	National Capital, Major Commercial Port
21	Italy	Asmara	Eritrea	1889–1941	National Capital, World Heritage

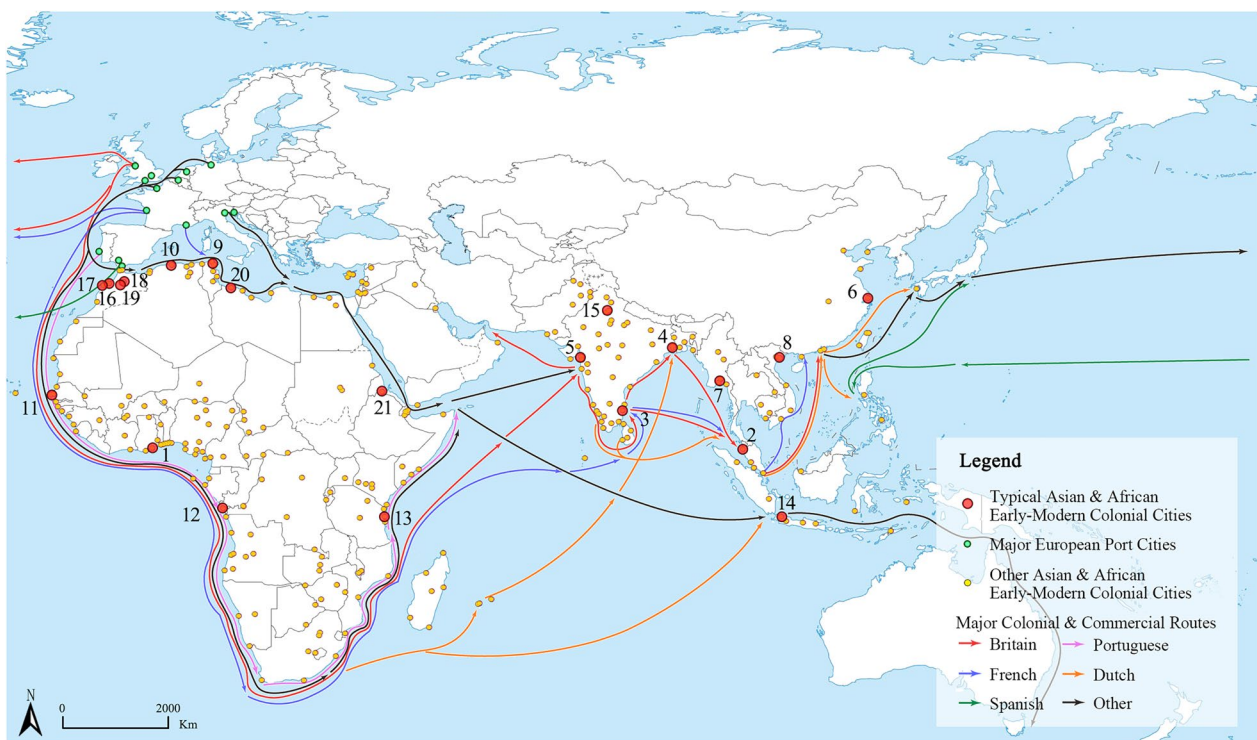


Fig. 3 European colonial routes and the distribution of major colonial cities in Asia and Africa [28]

continuity of differences existed in the colonial city, dominated planning and construction throughout the colonial period, and continued after the city's independence.

Spatial pattern types

Basically, the “Dual City” is formed because European colonies in Asia and Africa were based on native settlements rather than planning new towns. Therefore, as the size and developmental status of native settlements varied, there were three major methods for suzerains to plan colonies on the basis of native foundations (Fig. 4): (1) For areas with large native settlement foundations, with the consideration of racial segregation, old town conservation and construction costs, colonizers are more likely to plan a new town, resulting in two relatively independent areas that develop and expand separately nearby; (2) For areas with moderate native settlement foundations,

suzerains would prefer to build a new European zone close to the native settlement while also demolishing or replacing the native space gradually to follow the customary and functional needs of European living and planning. As result, a mediating zone that incorporated in both European and Asian and African styles is formed gradually or systematically, showing three semantic meanings of the spatial language and ; (3) For areas with small or scattered native settlements, the choice is to construct a new city or expand directly under a comprehensive planning scheme, but the differences in building density and spatial scale still enforce segregation between the European and native zones.

The “Dual City” is also reflected in the spatial division of social stratification within the colonies. Colonial cities amassed a considerable diversity of nationalities, races, and castes in South Asia. Colonizers in the European

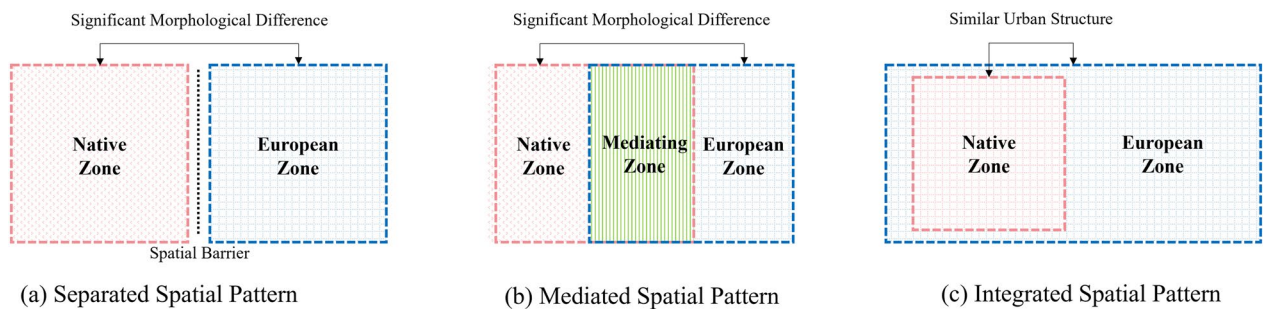


Fig. 4 Three spatial patterns demonstrating the “Dual City” model with the different spatial distribution of European and native zones

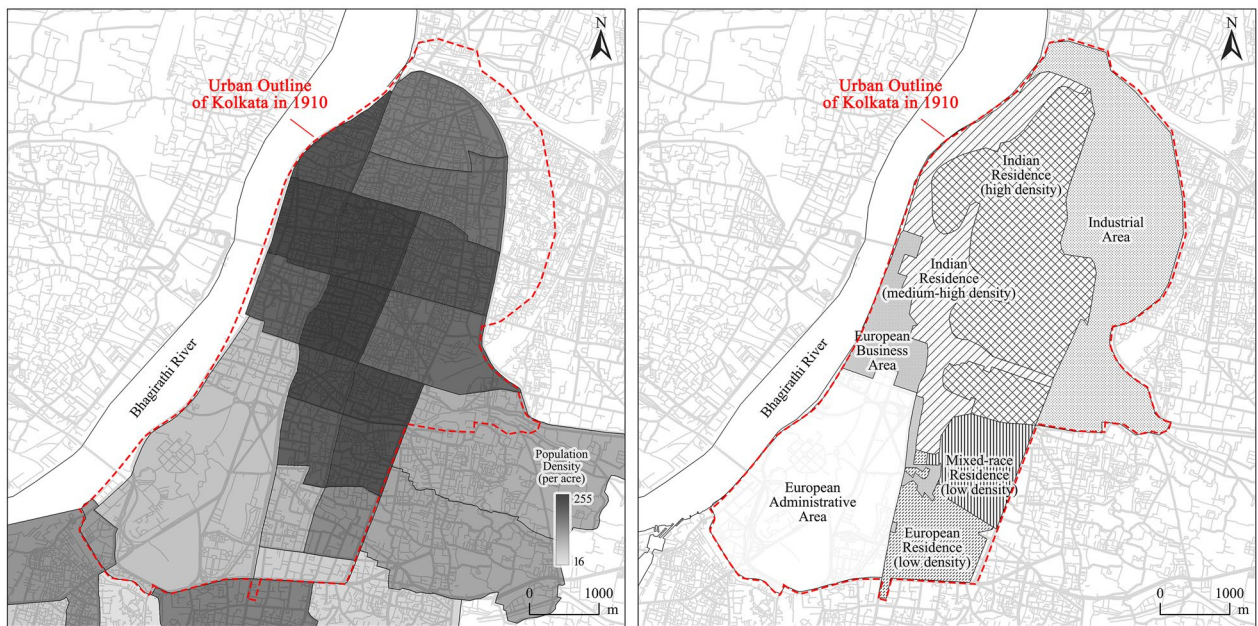


Fig. 5 Population density and land use type of Kolkata urban area in 1910 (Excluding suburbs) [31]

zone occupied the upper class, while Asians and Africans were relegated to the lower class and restricted in the native zone. Moreover, mixed-race individuals formed the middle class with different spatial division legislations in cities. For example, according to data from the 1910 Census and Urban Survey (Fig. 5), the population density in the European zone was only 63 persons per acre, while that the Indian zone reached 166 persons per acre. The commercial, residential, and administrative districts of Europe represent the low population density urban areas, while the zones for natives and Mixed Eurasian represent the high-population density areas of the city. This division of population densities corresponds to building densities, which ultimately create spatial contrast in this colony.

In addition, the characteristics of the “Dual City” could also be seen within the cultural differences between zones (Table 2), which could be concluded as: (1) separated native zones presenting the native cultural identity; (2) the European planning thoughts and cultures are applied in the European zone; and (3) an integrated culture could be seen within the zone that altered by suzerains. Thus, there are three combination types of urban cultural landscape due to the combination of different zones under the influence of culture: (1) a separated urban cultural landscape between native and European zone under the consideration of cultural preservation; (2) a mediated urban cultural landscape representing the cultural fusion of both native and European cultures; and (3) an integrated urban cultural landscape.

Table 2 Cultural identity difference demonstrated in typical colonial world heritage cities in Asia and Africa

Characteristic	World heritage	Inscription	Cultural identity	World heritage organization commentary
Native urban landscape	Medina of Fez	1981	Islamic culture	One of the most extensive and best conserved historic towns of the Arab-Muslim world
European urban landscape	Asmara: A Modernist African City	2017	Modernist urbanism	Combination of innovative town planning and modernist architecture in an African context and were used for functional and segregation purposes
Mediated urban landscape	Kasbah of Algiers	1992	Islamic culture, French classicism	Remains of the citadel, old mosques and Ottoman-style palaces, Mediterranean Muslim culture, synthesis of numerous traditions

Table 3 Spatial pattern types of typical Asian and African colonial cities

Number	Typology	City	Native zone	European zone	Mediating zone
1	Separated	Casablanca	Arab Town	French New Town	–
2		Rabat	Medina	French New Town	–
3		Tripoli	Tripoli Castle	Italian New Town	–
4		Tunis	Arab town	French New Town	–
5		Shanghai	Old City	Garden Villa	–
6		Delhi	Old City	French New Town	–
7		Meknes	Old Town	New Town on Highland	–
8		Fez	Arab town	Ville Nouvelle	–
9	Mediated	Hanoi	Civilian Area	French New Town	Imperial Citadel of Thang Long
10		Algiers	Caspar	French New Town	North Coastal Zone
11	Integrated	Pondicherry	Black Town	White Town	–
12		Kolkata	Bungalow, Bengaluru	B.B.D. Bagh ∙ Fort William	–
13		George Town	Shophouses	Kota Cornwallis	–
14		Asmara	Abbashawel	Administrative and residential areas	–
15		Dar es Salaam	Low-rise apartment	Classical government complex	–
16		Pointe-Noire	European Row House Architecture	Garden Villa	–
17		Mumbai	Row houses	Garden Villa	–
18		Accra	Native towns, industrial zones	Administrative districts, European zones	–
19		Yangon	Prefabricated building	commercial complex	–
20		Jakarta	Sheds or outbuildings	Apartments and Villas	–
21	Dakar	Medina	Commercial and residential buildings	–	

Thus, under the effects of different native settlement sizes, social structures and culture identities, there are three spatial pattern types can be classified for the “Dual City” model of Asian and African colonial cities, which are separated, mediated and integrated spatial pattern types (Table 3). Cities with separated spatial pattern types could be predominantly found in North Africa and South Asia, such as French-colonized Tunisia and British-colonized Meknes, where the native history is relatively long-standing. In this type, the urban

spaces of native towns in Asia and Africa are juxtaposed with those of new European cities, significantly forming urban spaces with two distinct visual and textural characteristics (Fig. 6). Mediated spatial pattern types could be found mainly in the French colonial regions of North Africa and Southeast Asia, exemplified by cities like Hanoi and Algiers. These cities have experienced significant transformation and reconstruction, with avenues forming as axes with memorial nodes at edges to emphasize the political order, though they are relatively few in



Fig. 6 Separated spatial patterns of typical Asian and African colonial cities

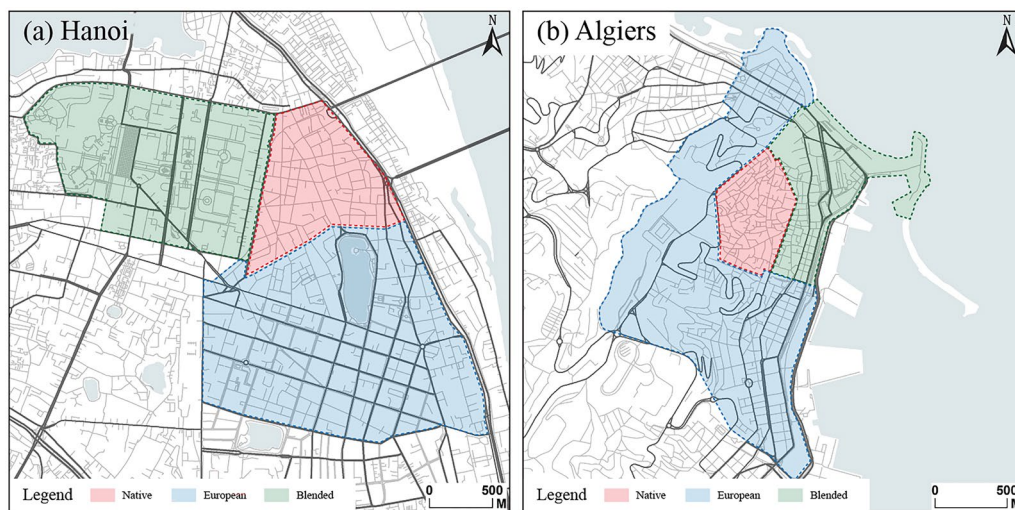


Fig. 7 Mediated spatial patterns of typical Asian and African colonial cities

number. Cities of this category feature distinct yet interconnected native and colonial zones, fostering integrated urban spaces. These mediating zones were planned to minimize morphological disparities between zones while strengthening political order, serving both as administrative hubs and commercial gateways (Fig. 7). Cities with integrated spatial pattern types, primarily spread across sub-Saharan Africa and coastal regions of South Asia and Southeast Asia, such as the British-colonized George Town and Mumbai, are basically planned and promoted by colonizers due to weak settlement foundations, and exhibit homogeneity in their spatial forms is exhibited (Fig. 8).

Spatial morphological elements

The three spatial urban pattern types of Asian and African colonial cities also influenced the characteristics of multi-level morphological elements, which could be demonstrated by the analysis of road network, urban fabric and urban core design.

Characteristics of road network

The characteristics of the road network can reflect the varied semantic meaning of urban forms, which could be used to recognize and compare native and suzerain zones in colonial cities. Curved roads, which indicate preexisting morphology [32, 33], tend to be found in native zones that existed before the colonial period, often showing a superblock structure [34] after the development during colonial time. Diagonal and gridiron roads, designed by suzerains for specific functions, tend to be found in altered or newly developed areas. Thus, there are differences in road centrality between these zones with different semantic meanings. The preexisting native superblocks have much lower road centrality compared to the suzerain-planned areas. In light of this, Space Syntax, which can be used to analyze the centrality of road in city, is applied in road network structure analysis. As a result, different road network structures are reflected in the three different spatial pattern types. The separated spatial pattern type (e.g. Tunis, Meknes) shows

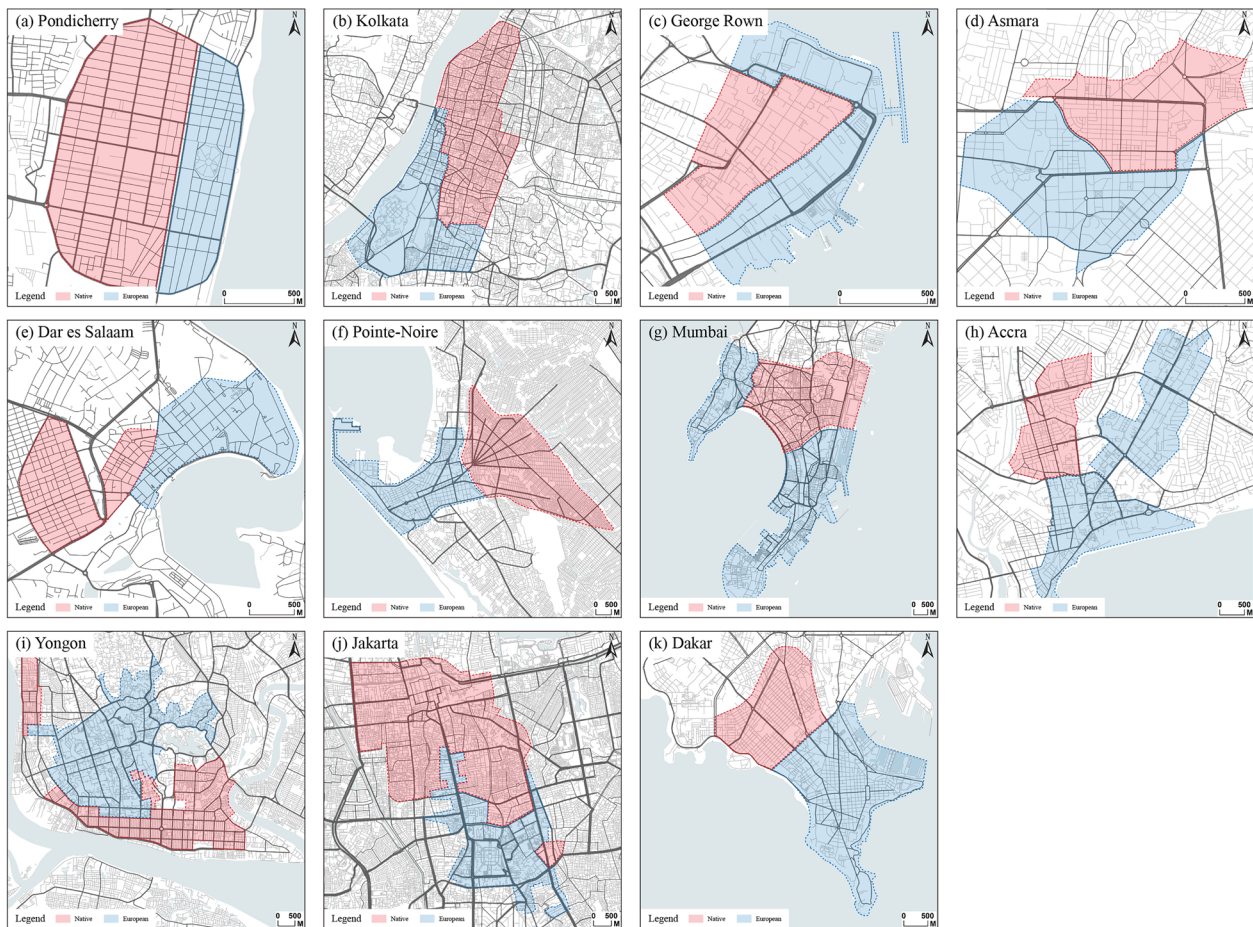


Fig. 8 Integrated spatial patterns of typical Asian and African colonial cities

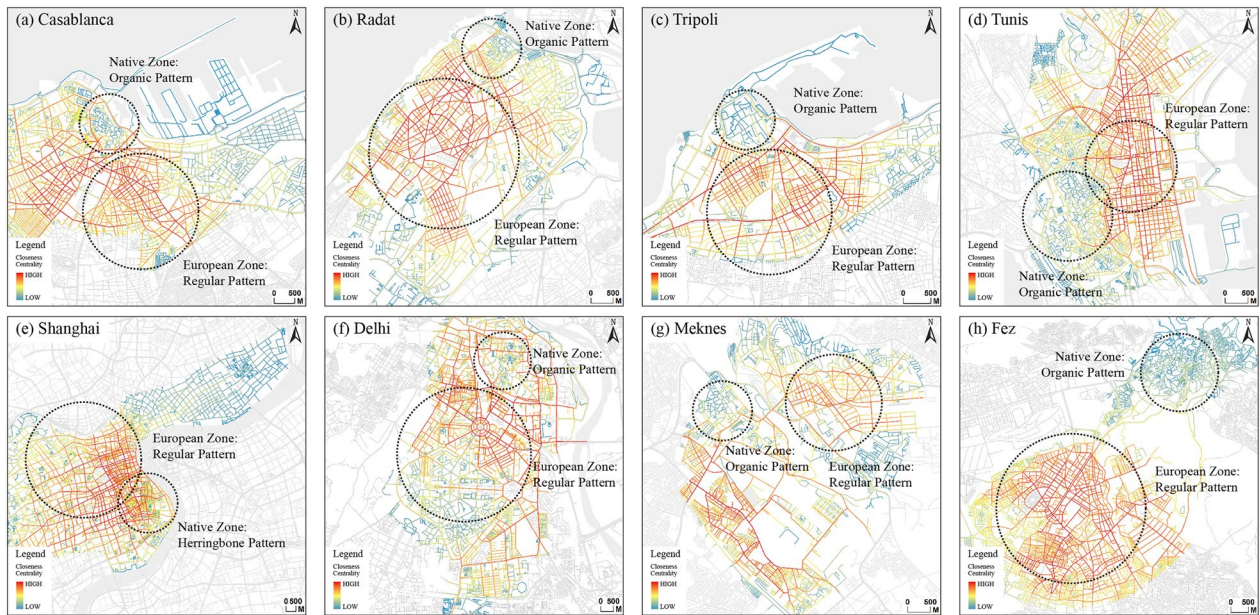


Fig. 9 Road network structures in typical Asian & African colonial cities of separated spatial pattern type

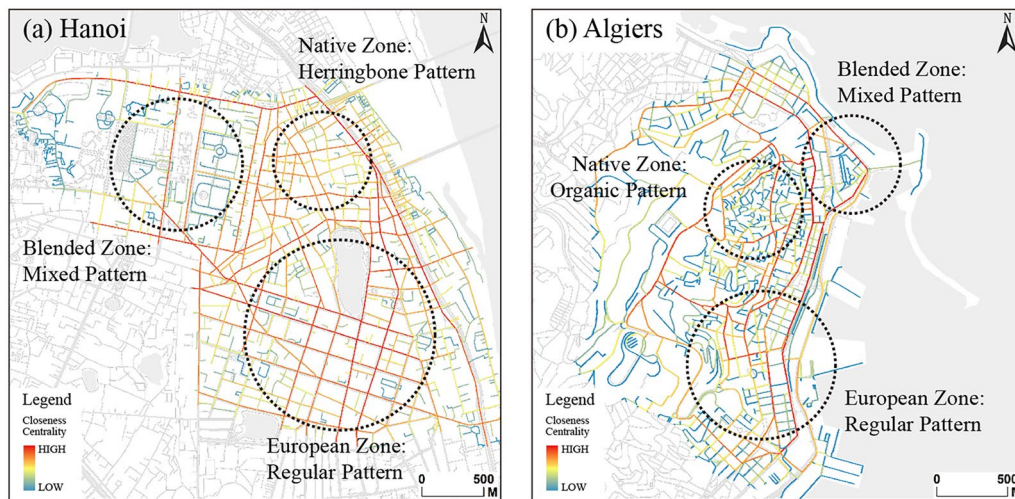


Fig. 10 Road network structures in typical Asian & African colonial cities of mediated spatial pattern type

significant difference between road network of native and European zones. The road centrality values are relatively higher in the European zones than native zones, showing a contrast of regular grid planning by European colonizers and organic planning by Asian and African where blocks have grown into superblock (Fig. 9). In the mediated spatial pattern cities (e.g. Hanoi, Algiers), areas with higher road centrality values are more evenly distributed across the city alongside the main roads which have been modified or rebuilt, though the original road networks

in the Asian and African sections still appear chaotic in contrast (Fig. 10). In the cities of integrated spatial pattern types (e.g. George Town, Mumbai), areas with high road centrality values are balanced or lean towards the Asian and African sections, with a higher degree of balance and stronger connectivity between different urban sectors. However, due to differences in population concentration and modes of travel, the road network density tends to be higher in the native zones overall (Fig. 11).



Fig. 11 Road network structures in typical Asian & African colonial cities of integrated spatial pattern type

Further analysis of the road network in colonial cities identifies three basic road network structures: grid, organic, and radial, serving the settlement and resident population, and a three-dimensional analysis of the built environment. The grid pattern facilitates vehicular movement and management, and is commonly found in European zones or uniformly planned native zones. The organic pattern conforms to the terrain and landscape, and is frequently observed in native zones or in European zones with unique topographies. The radial pattern emphasizes a central core and majesty, which is typical of administrative centers and landscape nodes in European zones, or spontaneously formed distribution plazas in native zones. Through the transformation and combination of these basic road network, the connectivity of road traffic and the segregation of functional spaces are achieved, presenting European zones as appropriately scaled, flexible, and public-space friendly. In contrast, native zones exhibit mechanical rigidity, dense and narrow spaces, or disorderly and chaotic forms.

Characteristics of urban fabric

Using figure-ground relationship qualitative analysis, the following characteristics of architectural fabric could be observed in the spatial pattern types: in the separated pattern (e.g. Tunis, Meknes), the architectural fabric of the European and native zones significantly differs. The former has lower building density, commercial and residential buildings distributed along the streets, and garden villas of larger volume, presenting an overall orderly arrangement. The latter shows high density, small scale, and organic layout. In the mediated spatial pattern (e.g. Hanoi, Algiers), the European zone is symmetrical and well-proportioned, while the native zone is tighter on the exterior and looser on the interior, dense on the outside and sparse on the inside. The mediating zone, however, showcases a unified exterior style with a freely scattered interior, reflecting the formative process of the fabric by suzerains on preexisting morphologies. In the integrated spatial pattern (e.g. George Town, Mumbai), the differences between the European and native zones are

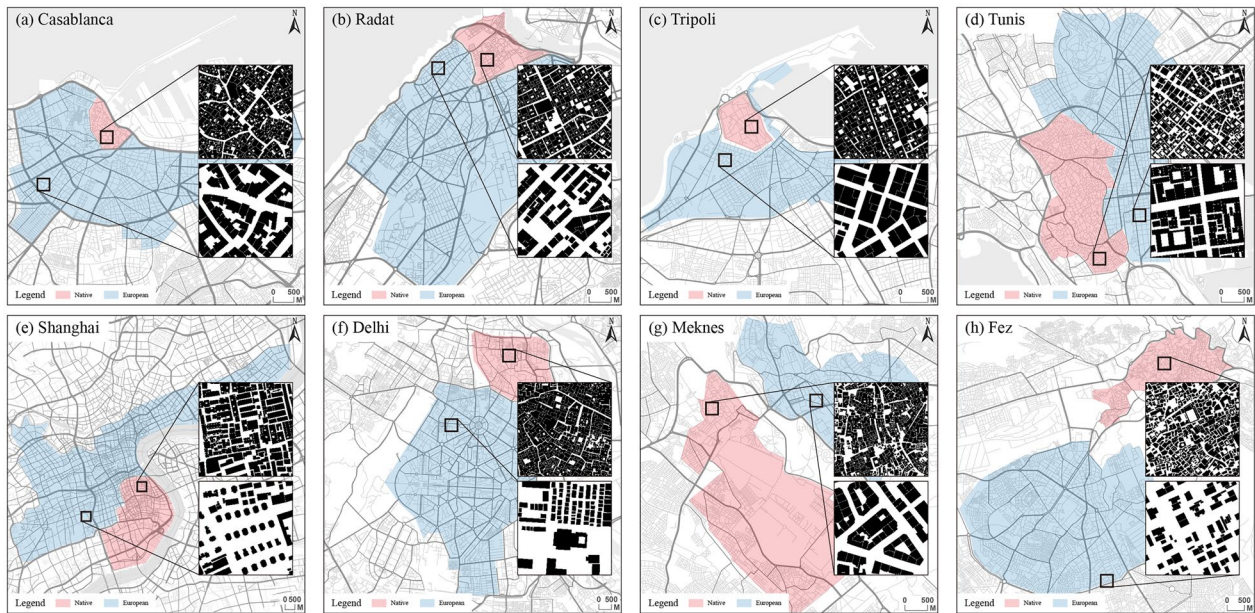


Fig. 12 Architectural fabrics in typical Asian & African colonial city of separated spatial pattern type

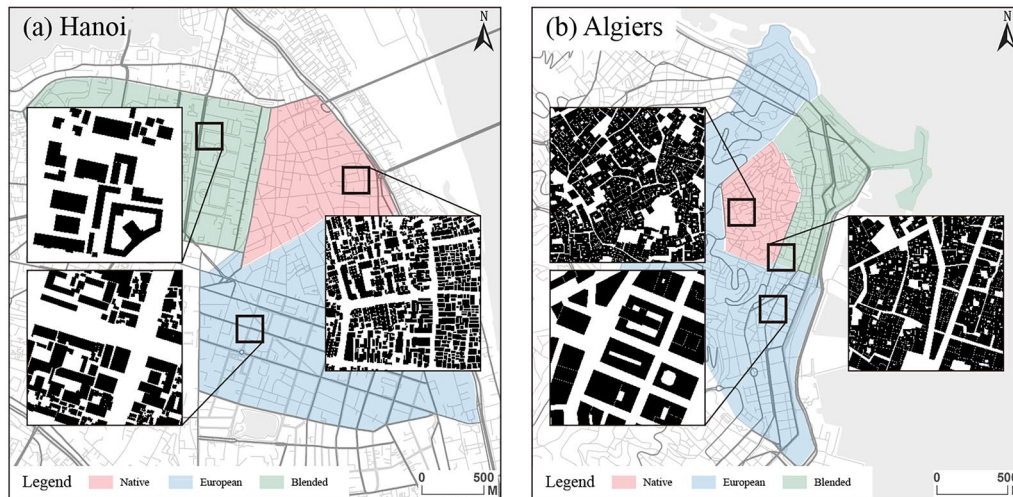


Fig. 13 Architectural fabrics in typical Asian & African colonial city of mediated spatial pattern type

relatively small, even tending towards homogenization. The distinction lies in the former having lower density, larger scale, and more public spaces.

From the perspective of architectural style, the architectural fabric of colonial cities in Asia and Africa exhibits distinct characteristics under the influence of the three spatial patterns. In the separated and mediated patterns (Figs. 12, 13), the native zones retain more complete native features, such as the native Tube Houses in Hanoi. Although these have been modified or rebuilt, they still display their

original fabric on major roads and street-facing facades, with a good degree of form conservation. The European zones, while maintaining a European style, also incorporate native architectural features. In the integrated pattern, both the European and native zones, following unified planning and construction and influenced by material limitations and customs, ultimately achieve a consistency in architectural fabric that blends native and foreign elements (Fig. 14).



Fig. 14 Architectural fabrics in typical Asian & African colonial city of integrated spatial pattern type

Characteristics of urban core

Based on the analysis of road network and fabrics, the design of core space of Asian and African colonial cities has clear functionality. In cities where the core space is dominated by governance functions (e.g. Hanoi, Kolkata), the layout revolves around major buildings, axes, or squares, featuring lower building density and a pleasant

landscape environment. In cities where the core space is dominated by economic functions (e.g. Shanghai, Yangon), docks serve as the origin of coordinates, with road networks perpendicular to the shoreline, prominent commercial buildings, and a compact spatial layout facilitating port trade, railway transportation, mineral extraction, and other economic activities. In cities where

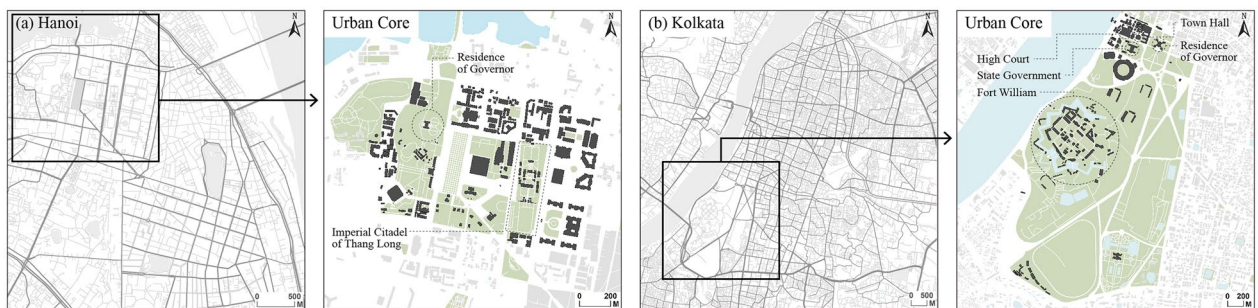


Fig. 15 The design of urban core dominated by governance functions in typical Asian & African colonial city

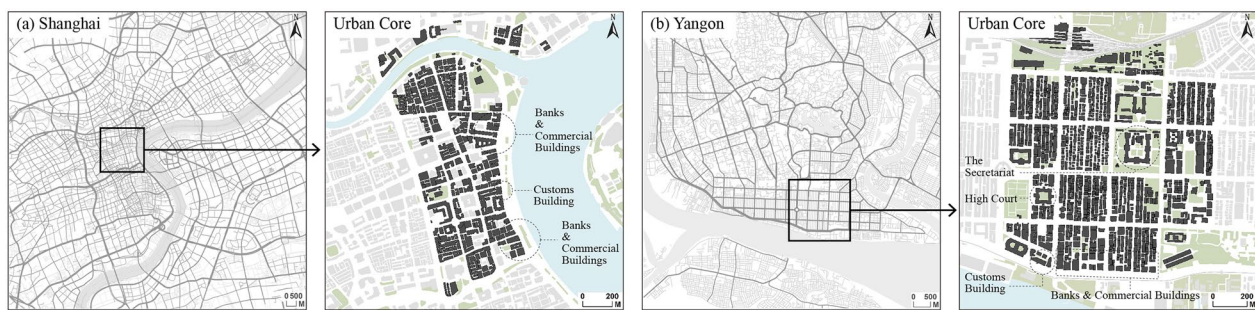


Fig. 16 The design of urban core dominated by economic functions in typical Asian & African colonial city

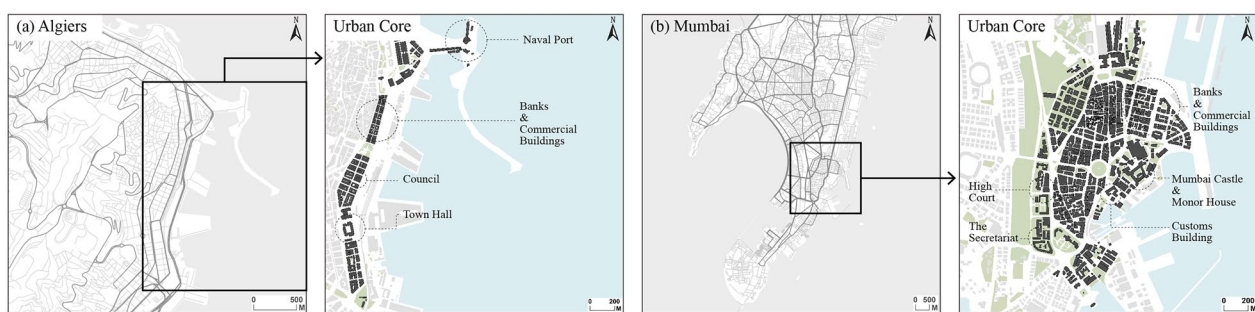


Fig. 17 The design of urban core dominated by composite functions in typical Asian & African colonial city

the core space is dominated by composite functions (e.g. Algiers, Mumbai), often serving as colonial capitals and economic centers, there is a clear functional zoning with stronger spatial integrity.

Focusing on the core spaces, the primary functions of cities during the colonial period revolved around governance and economics. In core spaces dominated by governance functions, defensive structures or landscape spaces were constructed either wholly or partially to underscore the majestic image of the ruling entity's main buildings [35] (Fig. 15). Core spaces dominated by economic functions typically featured higher building densities, with architectural styles and heights lacking uniform control (Fig. 16). Core spaces with composite functions lacked an overarching unified planning and, as the city developed and expanded, incorporated more functions related to culture, religion, education, and healthcare (Fig. 17). Although these areas gathered numerous public buildings, the architectural forms and styles were diverse, and there was a lack of public space.

Discussion

The previous sections have provided an analysis of the morphological characteristics of colonial cities in Asia and Africa, and a "Dual City" model has been identified as the major characteristic of these cities. To further

understand the underlying factors influencing the formation of these colonial urban forms, it is necessary to conduct an examination from multiple perspectives, including the intentions behind urban construction and the social context. Better inheritance and conservation could only proceed by understanding the rules and mechanisms behind the formation of colonial urban forms under this "Dual City" model.

Impact factors

From military distinction to policy promotion

From the perspective of spatial patterns, colonizers divided people from different racial and cultural backgrounds into racial zones, resulting in a collage of racially divided residential regions [36]. Military considerations played a major role in the site selection of the European zone. The higher terrain was mostly chosen to as defense to maintain a greater distance from the Asian-African zone. Military facilities and troops were also stationed there for defense, with a large area of greenery used asact as a military buffer. This strengthened the military force and zoning isolation through this spatial and physical planning strategy [37].

From the standpoint of urban management, the colonizers tended to stand on the high ground of their rulers and, by respecting and assimilating the native

cultures of Asia and Africa, established the spatial order of the colonized cities and promoted the diversified integration of the people who used the urban space, to achieve peaceful coexistence and co-development with the Asian and African groups, even though they had the dominant power over the urban space. Consequently, policies that supported these groups' access to better urban spaces and facilitated the integration of European and native urban spaces were enacted by European colonizers. These urban modifications and reconstructions, including the construction of radial roads and nodal functional space, not only promoted the urban condition but also emphasized the hierarchies through the fabric design.

From authority creation to quality innovation

From the perspective of road network structure, the development focus was located in the European region, characterized by low curvature, strong connectivity, and high integrity of the main road network. Colonizers primarily adopted a grid pattern for roads, not only for rapid military expansion but also for systematic management, the creation of authority, and ruling purposes, as well as for commercial objectives like land sales and the maximization of benefits. However, colonizers would also resort to a freeform road network due to specific topographical features, economic considerations, and the desire to create landscapes. For existing freeform networks, there would be no extensive reconstruction but rather minor modifications to major roads with functional buildings and nodal spaces. Furthermore, the construction of new towns in colonial cities emulated the garden city concept, applying radial road networks while fully considering the experimental cost of trial and error.

From the standpoint of residential quality, in early colonial cities, the early construction of colonial cities in the European zone directly replicated European architectural styles and urban forms without effectively utilizing native materials, leading to building corrosion, river blockages, and rampant diseases. This resulted in the migration and formation of a linear dumbbell-shaped city pattern with new suburbs and the original old city [38]. Similarly, in the Asian and African regions, measures such as road and green space segregation, land and water source management were implemented to prevent the spread of epidemics [39]. While strengthening ruling authority, there was also an emphasis on gaining recognition to stabilize rule; thus, native elements were incorporated into architecture and landscape design. This approach led to the creation of many buildings and landscapes with integrated styles, further improving the native spatial environment.

From class segregation to culture fusion

From the perspective of architectural fabric, Classicism and Modernism dominated the European zone, with architectural arrangements presenting either enclosed or dotted layouts, while the native areas exhibiting a mixture of architectural styles. European colonizers, as the ruling class of the city, typically had a high degree of control and dominance over the limited urban space. Consequently, the spatial planning of the city became a core tool for colonizers to manipulate the activities of different racial and social classes within the city [40], reinforcing the differentiation and segregation of spaces among various classes through direct, indirect, or potential manipulation.

From the standpoint of society and culture, the cultural exchange between Europe and native is multifaceted, emerging from the interaction and communication between European cultures and native cultures. At its core lies a system of institutions, including governments, education systems, family organizational models, economic institutions, languages and literatures, technologies, social beliefs, and cultural artifacts (including architectural forms and urban patterns) [41]. The fusion and interweaving of these urban elements are visibly apparent in the material spatial forms. In contrast, the deeper level involves cultural exchanges at the ideological and institutional system levels. Through international talents, academic journals, industry media, etc., the urban elements of Europe and the native regions continue to persist within colonial cities.

From profit motivation to planning transformation

From the perspective of core spaces, the governance function spaces were constructed by the colonial government, emphasizing the materialization of intangible ruling authority, thus prioritizing the creation of a solemn atmosphere. These spaces skillfully utilized greenery and axes to highlight buildings, ultimately forming a core spatial arrangement centered around a fortress. Economic function spaces generally came from various commercial companies, with various construction years, material structures, façade styles, and building heights. Aimed at pursuing economic benefits, these spaces experienced significant land development intensity, often neglecting the creation of public spaces. Consequently, the buildings lacked uniformity in form, style, and height.

From the standpoint of planning thoughts, the phased transformation of European urban planning models plays a direct role in driving the change in spatial forms of Asian and African colonial cities. The historical stratification of built areas in European cities means that the application of new urban planning models in practice requires

a lengthy process of old town renewal, transformation, or new town construction. Therefore, European colonizers often treat colonial cities as experimental grounds for urban planning. From the religious hues of the Middle Ages to the modernist urban movement of the twentieth century, European urban planning thoughts have provided reference schemes for the construction practices of Asian and African cities at various historical stages, becoming a guiding force in driving the transformation of spatial forms.

Conservation strategies

The historical space of Asian and African colonial cities emerged and flourished on native continents, making them important carriers of global multiculturalism. Despite high value, it has not yet to be universally protected and recognized worldwide. In the postcolonial setting, how to critically explore the findings to link them to colonial heritage conservation strategies is an important question for future societies and academic circles to consider and investigate.

Preserve natural environment

Historical urban forms include not only buildings and blocks, but also traditional ecosystems that coexist with the natural environment. The topography of the terrain and climatic conditions have a significant influence on the design of urban settlement [42], especially in colonization contexts such as Africa and the Asia, where heights have represented strategic points of military control. The urban pattern types of Asian and African colonial cities are also the demonstration of different allocation and planning preferences for environment. For example, in most of the discussed typical cities, both the native and European zones are located near water, but they are situated on different terrains. Thus, protecting the natural environment helps preserve the original appearance and historical memory of these cities. It is necessary to rediscover the latent potential of the natural environment and pay attention to the implications of climate change and the ecological crisis [43]. This process should adapt to the influences of climate, terrain, and materials, integrating the natural environment and cultural landscapes, to design architectural styles that are more reflective of local characteristics.

Develop universal policies

The colonial cultural heritage of Asia and Africa is a precious cultural resource for all related countries, and every nation should have the responsibility to identify, preserve, display this special type of cultural heritage to future generations. Thus, it is necessary for the development of universal legislation and policies for these colonial cities

after the understanding of their urban morphological characteristics. The research result of "Dual City" urban model and element characteristics conclusion enhanced the importance to development of guidelines and policies for the protection of colonial morphology by zones.

Respect native landscape

As a result of the research, the shape of the Asian and African colonial cities often reflects the architectural and urban planning choices implemented, highlighted in the geometry of the building plots and cadastral blocks. Although some colonists respected the native cultures of Asia and Africa by protecting old cities, implementing urban zoning, and constructing new towns, many native landscapes were weakened, suppressed, or even eradicated during the colonization process. It is essential to respect native traditions, protect morphological characteristics, improve living environments, and use local materials. Planning and design should be employed to restore traditional culture and order. The integration of European architectural styles with the native culture and climate of the colonies should be pursued, ultimately leading to a harmonious mediation.

Revitalize nodal spaces

In the context of postcolonialism and cultural heritage conservation, most nodal spaces and palaces of power continue to be used by citizens after independence, while being preserved, rebuilt, and transformed to meet current demands. As a result, the true value of colonial history has evolved from symbolizing the remains of invasion and oppression to serving as locations where users can shape new cultures and spirits [44]. Currently, the functions of colonial heritage are divided into two categories: one is the singular display function of colonial heritage, which focuses on castles, prisons, or other specific colonial facilities, and the other includes administrative, commercial, educational, and cultural functions. For colonial heritages with various roles, appropriate steps should be taken with the appropriate understanding of morphology based on the "Dual City" patterns discovered in the research to identify and revitalize the nodal areas.

Conclusions

The historical spaces of colonial cities in Asia and Africa exhibit the "Dual City" spatial urban pattern, demonstrating a binary differentiation between European and native zones, showing the different semantic meaning of forms generated by varied time and planning purposes. This can be categorized into three spatial pattern types with morphological and semantic differences. In the separated pattern, the native area conserves well, preserving its

original fabric, whereas the European area is outwardly divergent, displaying a more modern appearance and a strict layout. In the mediated pattern, after intervention and alternation, the native area creates a fusion zone that serves as a stylistic bridge, leading to a more cohesive urban space. In the integrated pattern, uniformly planned by colonizers, the Asian and African context is weaker, with the city's form and appearance generally reflecting a European style. Under the influence of these three spatial patterns planning methods, different morphological elements can also be observed between zones, illustrating the "Dual City" urban model of Asian and African colonial cities.

The formation of colonial cities in Asia and Africa, under the "Dual City" urban model, has been influenced by multiple factors. When considering the dimension of different morphological elements, the characteristics presented by each element under various colonial purposes and functional dominances differ significantly. There is a notable variance in the primary distribution areas and emergence periods of different spatial patterns, which in turn influenced other morphological elements. Asian and African colonial cities exhibit both segregation and integration. Segregation is manifested through the differentiation of urban spaces driven by military, governance, class, and economic disparities. Meanwhile, integration is evident in the circulation among management, environmental, cultural, and scientific elements, promoting the fusion of urban planning ideas and Asian and African urban cultures within colonial cities, thereby endowing them with significant cultural heritage value. A series of further quantitative studies could be conducted to reveal the interaction between the morphological types and influencing factors of Asian and African colonial cities.

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WW was responsible for conceptualization, supervision, writing-review and editing; LL was responsible for framework, formal analysis, interpretation, visualization and paper writing; NZ was responsible for the methodology, validation, and writing; QS was responsible for data collection, data curation and visualization. All authors read and approved the final manuscript.

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Competing interests

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