Preface

PREFACE

HABITechno 7 x The Visaca International Conference 2025

Habitat for Tomorrow: Affordable, Inclusive, and Sustainable Living

Habitechno is a biennial international conference hosted by the Building Technology Research Group and the Housing and Human Settlements Research Group of the School of Architecture, Planning, and Policy Development (SAPPD) at the Institute Technology of Bandung (ITB). Since its inception in 2013, Habitechno has served as a vital platform for academics, researchers, practitioners, industry professionals, and policymakers to address pressing global challenges in habitation. The conference reflects on the potentials and challenges of housing and settlement development, exploring technological innovations across the past, present, and future.

Over the years, Habitechno has consistently advanced discourse on housing and settlement development, with a particular focus on the needs of low-income communities. Researchers and stakeholders, including national and local governmental bodies, have actively participated in expanding knowledge and perspectives to tackle the complex challenges in housing and settlement development. By bringing together a diverse range of participants, Habitechno has become a melting pot for multidisciplinary and multisectoral collaboration, fostering innovative and sustainable solutions for societal needs.

Habitechno 7 builds on this legacy by addressing emerging challenges and opportunities in sustainable habitat development, ensuring its relevance in a rapidly changing global context. The theme for HABITechno 7 is **"Habitat for Tomorrow: Affordable, Inclusive, and Sustainable Living."** This theme reflects HABITechno's long-standing commitment to innovation and inclusiveness while addressing the growing issue of affordability amid widening global inequalities. In addition to stimulating dialogue, the event aims to generate actionable strategies and collaborations that bridge traditional wisdom and modern technology. By emphasizing equity and resilience, HABITechno 7 aspires to create pathways for sustainable and inclusive urban futures.

This year's HABITechno benefits from the diverse contributions of two key academic partners: Udayana University and Warmadewa University**,** both of which bring unique expertise to the table. The Visaca at Udayana University plays a vital role in advancing architectural and urban development research in Bali.

HABITechno 7 x The Visaca International Joint Conference 2025 represents a significant milestone in advancing affordable, inclusive, and sustainable habitation. Warmadewa University has shown its commitment to local wisdom and sustainability as the host of 2-weeks bamboo workshop.

The main objectives of HABITechno 7 are:

- Knowledge sharing: Enhancing participants' understanding of best practices and the latest research in the field of housing and settlement, as well as encouraging interdisciplinary dialog.
- Collaboration and Networking: Building networks between academics, government, industry, and communities, and facilitating collaboration for real-world projects.
- Policy and Practical Impact: Delivering policy recommendations based on discussions and conference outcomes, and encouraging the implementation of practical solutions at local and global levels.

The HABITechno 7 activities is designed to maximize intellectual exchange and practical engagement, consisting of three main components:

- International Conference (6 November 2025): Serving as a platform for high-level discussions and knowledge dissemination.
- Bamboo Building Workshop (26-32 October, 3-5 November 2025): Providing online tutorial and hands-on learning opportunities that integrate traditional craftsmanship with modern architectural practices.
- Energy and Green Calculation Workshop (4 November 2025): Practical sessions on the fundamentals of energy efficiency, sustainability, and calculations for eco-friendly buildings.

We would like to extend our heartfelt appreciation to Udayana University and Warmadewa University as our university collaborators, whose support and partnership have been invaluable to this initiative. We also express our sincere gratitude to all colleagues of Habitechno 7 whose dedication and contributions have been essential to the success of this event. Our sincere thanks go to the Habitechno 7 Committee for their commitment and tireless efforts in organizing the program, as well as to the Faculties of the School of Architecture, Planning and Policy Development for their academic support and guidance. We are also deeply grateful to the Keynote and Invited Speakers for sharing their valuable insights and expertise, and to the Reviewers for their careful evaluation and constructive feedback, which have greatly enhanced the quality of this work.

Habitechno 7 Committee would like to express our sincere gratitude to all parties who have generously supported this initiative through funding, sponsorship, collaboration, and valuable contributions. Our deepest appreciation goes to Institut Teknologi Bandung for its academic, institutional support, as well as financial assistance. We also extend our special thanks to Virobuild, Pacific Paint, Dekkson, Sarana Multigriya Finansial LLC and ACC Japan for their generous sponsorship, which has been instrumental in supporting the implementation and overall success of this program.

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Resilience Patterns in Urban Public Spaces: A Comparative Morphological Analysis of Yogyakarta and Jakarta from the 18th to 21st Century

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Abstract. This paper examines the resilience patterns of urban public spaces in two major Indonesian cities—Yogyakarta and Jakarta—by analysing how historical, socio-economic, ecological, and morphological factors inluence their persistence and transformation over time. The study employs urban tissue analysis with an element-based approach through a diachronic study of public place typologies across four time periods from the 18th to the 21st centuries. Four case studies are analysed: Alun-Alun and Embung Langensari in Yogyakarta, and the Silang Monas Area and Banteng Field in Jakarta. Variables examined include transformation cycles, element persistence, building coverage ratio, block density, intersection density, and natural context. Results reveal that the natural context was the most persistent element across all case studies. Urban squares in Jakarta exhibit greater spatial persistence than those in Yogyakarta, indicating that, despite facing similar global challenges (climate change, economic inequality, social transformation), each city's resilience patterns are uniquely shaped by its distinct socio-historical context. This comparative analysis of urban public space resilience over an extended historical period provides insights into the interaction between urban morphology and socio-ecological factors in shaping resilient cities, while offering urban planners valuable guidance for developing contextual resilience strategies that balance persistence with necessary transformation.

1. Introduction

The essence of urban public places extends beyond their physical manifestation to encompass their role as repositories of collective memory and agents of urban change. Through a historical perspective, Kostof identiies three primary drivers of urban form transformation: natural disasters, large-scale urban development interventions, and incremental change through thousands of alterations and adjustments.[1] Since the emergence of cities 7,000 years ago, urban form has manifested various human civilisations globally.[1, 2] However, the past century has witnessed unprecedented acceleration in urban development, with urban populations increasing dramatically and posing signiicant challenges to sustainability.[3]

This paper examines resilience patterns of urban public spaces in two major Indonesian cities—Yogyakarta and Jakarta—by analysing how historical, socio-economic, ecological, and

morphological factors inluence their persistence and transformation over time. These cities represent contrasting trajectories of urban development in Indonesia. Jakarta, established as the capital of the Republic of Indonesia in the mid-20th century, embodies global and colonial inluences dating back to the early 17th century. Its development relects successive layers of Dutch colonial planning, Japanese occupation, and post-independence nationalist aspirations.
Conversely, Yogyakarta, capital of the Ngayogyakarta Hadiningrat kingdom established in the mid18th century, represents the traditional Javanese inland city where royal patronage and indigenous spatial concepts have shaped urban form.

Both cities inherited signiicant open spaces that originally served as symbols of political power and subsequently transformed into public spaces that serve dual functions: gathering places for social interaction and ecological infrastructure for environmental sustainability. The transformation of these spaces from exclusive domains of power to inclusive public realms relects broader societal changes in Indonesia, from colonial subjugation through independence to contemporary democracy. Understanding these transformations provides insights into how urban public spaces negotiate between persistence and change, tradition and modernity, local identity and global pressures.

Understanding these transformations requires integrating multiple theoretical perspectives. The morphological approach to urban analysis provides essential tools for understanding urban transformation. The Conzenian school emphasises three fundamental elements: town plan (streets, plots, buildings), building fabric, and land use[4]. These elements transform at different rates, making the town plan most resistant to change. Kropf extends this through hierarchical decomposition, identifying how urban tissue comprises interrelated spatial elements at multiple scales.[5] The Italian typological school, represented by Muratori, Caniggia, and Maffei, focuses on the evolution of building types within urban contexts.[6]

In the Indonesian context, these morphological processes are complicated by postcolonial dynamics. Kusno demonstrates how Jakarta's urban form relects successive layers of political ideology, from colonial control to nationalist aspirations.[7] King argues that colonial cities exhibit dual structures—indigenous and European quarters—that persist despite political transformation.[8] Bishop emphasises how postcolonial cities negotiate between preserving cultural identity and embracing global modernity, creating hybrid urban forms.[9]

Contemporary urban resilience frameworks offer additional insights that integrate multiple dimensions. The City Resilience Framework by Arup, published in 2014, identiies four dimensions: health and wellbeing; economy and society; infrastructure and environment; and leadership and strategy.[10] Meerow et al. deine urban resilience as "the ability of an urban system to maintain or rapidly return to desired functions in the face of disturbance."[11] For morphological resilience, Feliciotti et al. propose ive principles: diversity, redundancy, modularity, connectivity, and eficiency[12]. Marcus and Colding emphasise spatial resilience through urban form characteristics that enable adaptation while maintaining identity[13].

Furthermore, Southeast Asian cities exhibit unique characteristics that require specialised analytical frameworks. McGee introduced the concept of "desakota", describing the rural-urban continuum characteristic of Indonesian cities[14]. Evers and Korff identify how Southeast Asian urban spaces relect complex negotiations between tradition and modernity[15]. Evers emphasises the role of symbolic continuity in Indonesian cities, where traditional spatial concepts persist within modern urban forms. These perspectives highlight the need to adapt Western urban theories to Southeast Asian contexts.[16]

The theoretical framework for this study draws from recent advances in urban resilience theory, particularly the integration of ecological systems concepts with urban morphological analysis. Carmona compiled a matrix of sustainable design principles, noting how various scholars have conceptualised resilience[17]: Bentley and Evans et al. equated it with process and change[18, 19]; Houghton & Hunter emphasised lexibility[20]; Le Fort and De Visscher highlighted the role of typomorphological diversity in enabling urban form to adapt and change over time[21] Frey highlighted adaptability.[22] Despite terminological differences, Carmona distinguishes between resilience and robustness: "Resilience is the ability to resist change without undue deformation: that is, it resists physical and structural obsolescence. Robustness is the ability to accommodate change without signiicant change in physical form: that is, it resists functional obsolescence".

The relationship between resilience concepts and urban form has been extensively explored through ecological systems studies. Romice et al. explain striking similarities between the Adaptive Cycle concept in ecology and urban morphological models, particularly Conzen's burgage cycle and Caniggia & Maffei's territorial development [23]. These models suggest three key principles: First, urban structures at each spatial scale possess life cycles progressing through identiiable phases; Second, phase transitions in these life cycles are physically observable as discrete responses to broader systemic changes; Third, structures at every stage and cycle are inluenced by persistent elements from previous structures that constitute the essential character of place.

This third principle resonates strongly with Aldo Rossi's theory of permanence in "The Architecture of the City", which adopts Poète and Lavedan's emphasis on examining persistent urban structural elements[24]. According to Rossi, permanent or persistent elements tend toward stability or slow change, subsequently becoming elements that confer special character to urban spaces. These elements are fundamental components that characterise areas or cities, serving as references for subsequent development and growth.

Urban resilience studies have received attention and developed at the conceptual level since Agenda 21, but operational studies have only developed relatively recently in the past decade. Recent urban resilience studies propose quantitative evaluation and measurement methods [25, 26, 27], while studies using qualitative methods remain relatively limited.[12, 21] Meanwhile, combining the two methods is needed to observe a comprehensive and resilient urban focus from socio-cultural, economic, and ecological aspects. Table 1 synthesises how different analytical stages correspond with established resilience principles, guiding the methodological approach:

Table 1 Compatibility Matrix of Urban Public Place Identiication Stages with Resilience Principles.

	Phase	Information	Source
1.	Transformation Cycle	Identifying the dynamics of the evolution of complex urban public places as a transformation cycle process: institutional, replenishment, climax, Recessive	Transformation cycle [30, 31, 33, 36]
2.	Persistence Matrix	Identify the dynamics of each element of the urban public place's response to the challenge of change in each transformation period.	Public place transformation [17]
		Identify various typologies of urban public place elements in each transformation period.	Persistent elements as character determinants [24]. Diversity [23, 28, 29]

3.	BC Ratio	Identify the building density by the area of building coverage divided by the area of urban tissues. Building density indicates the stages of the transformation period.	Building Density[30, 32, 33]
	Block Density	The number of blocks is identiied by dividing the area of urban tissue. More blocks indicate a better level of regional connectivity. The block density is the number of blocks/ 1 km^2 for comparability between cases.	Connectivity, Redundancy, Modularity, Eficiency [12, 23, 29]
	Intersection Density	The identiication of the number of road intersections divided by the area of urban tissue. The increasing number of intersections indicates better connectivity, redundancy, modularity, and eficiency. For comparability between cases, the number presented is the number of intersections / 1 km^2.	
	Natural Context	Identify the intensity of the natural context by dividing the areas of green and blue spaces by the area of urban tissues. Building density indicates the stages of the transformation period.	Self-suficiency [29]

In the framework of urban morphology, a diachronic, historically qualitative approach is more appropriate for explaining socio-cultural aspects, including the analysis of actors and inluential factors in the formation of cities. Meanwhile, synchronous studies focus mainly on economic and ecological aspects, including the quantitative evaluation of urban environmental performance parameters. The differences between the two methods tend to shift the focus of different studies, so we must refer to a series of studies on urban resilience. This study seeks to ill a methodology gap by rapidly assessing indicators of resilience in selected cases of transforming urban public places.

Contemporary global challenges—climate change, transportation crises, spatial limitations, economic inequity, and rapid urbanisation—pose similar threats to cities worldwide.[34] The United Nations addresses urban development in Agenda 11 of the SDGs, using the keywords inclusive, safe, resilient, and sustainable. Regarding sustainable development and urban resilience, the New Urban Agenda, adopted in 2016, identiies urban form, infrastructure, and building design as primary determinants.[35] However, while contemporary urban issues tend to be similar globally, responses vary signiicantly across local socio-cultural, economic, and ecological contexts.

This raises critical questions about the future of urban public places in postcolonial cities such as Jakarta and Yogyakarta. The hypothesis driving this research suggests that changes in urban public place forms built in previous eras may be replaced by new forms aligned with contemporary socio-cultural, economic, and ecological imperatives. Consequently, locally speciic elements that form urban public places in each city—originally highly distinctive—may become increasingly global and universal.

To investigate this hypothesis, this study employs comparative morphological analysis across four time periods from the 18th to the 21st centuries. Four case studies were selected to represent different typologies of urban public spaces: Alun-Alun Utara (North Square) and AlunAlun Selatan (South Square) in Yogyakarta, and the Medan Merdeka area (including the National Monument) and Lapangan Banteng in Jakarta. These cases represent active gathering places (Alun-Alun and Monas) and green urban spaces (Embung Langensari and Banteng), each serving as a city node with a relatively long history and exhibiting multiple observable transformation layers.

The research employs urban tissue analysis with an element-based approach through a diachronic study of public space typologies. Variables examined include transformation cycles,

element persistence, building coverage ratio, block density, intersection density, and natural context. This comprehensive methodology enables the identiication of resilience patterns shaped by the complex interplay of historical, socio-economic, and ecological factors over approximately 200 years. The research questions guiding this investigation are:

RQ1: What transformation cycles occur in each urban public place?

RQ2: How is the persistence of elements manifested in each urban public place?

RQ3: What is the relationship between transformation cycles and resilience levels of each urban public place?

By addressing these questions, this study contributes to urban resilience theory by providing empirical evidence from Southeast Asian cities, demonstrating how different socio-political contexts shape distinct resilience patterns despite facing similar global challenges. The indings offer valuable insights for urban planners and policymakers developing contextual resilience strategies that balance necessary transformation with preservation of local identity and cultural continuity.

2. Materials and Methods

In general, at the diachronic stage, the method used is urban tissue analysis with an elementbased approach.[36]. The urban tissue observed is an urban public place block deined by the elements of the surrounding blocks. The elements that form the urban tissue are broken down into streets, buildings, blocks, and natural contexts. The transformation of each element of the urban place is studied diachronically through sequential historical interpretation, visualised in 2D and 3D images, which differ slightly from the sequencing plan.[36] This study, which relies on tracing only on maps, conducts 2D-3D visualisation and reconstruction, combining cartography base maps with other sources such as photographs and historical texts [37]. This method accounts for the inconsistent accuracy of old map sources across periods. Furthermore, this sequential visualisation can be compiled to produce a permanence matrix for each element that comprises an urban public place. At the synchronous level, the study of resilience indicators refers to the work of Feliociti, Romice, and Porta et al., which seeks to summarise the approach to evaluating the resilience of urban forms in 5 principles: Diversity, Connectivity, Redundancy, Modularity & Eficiency.[23] Meanwhile, Liu's study proposes four principles: diversity, decentralisation, connectivity, and self-suficiency.[29]

The table below explains the stages in this study. This study identiies the transformation cycle and the persistence matrix at the operational analysis level. The principles of using the method in this study are: 1. Explaining the stages of the gradual process (transformation cycle); 2. Finding the elements that form a persistent urban public place (persistence matrix); 3. Finding the level of resilience (BC ratio, intersection density, block density, ecological network).

2.1. Study Areas and Case Selection

This research examines four urban public spaces across two Indonesian cities, selected through purposive sampling based on: (1) historical continuity spanning 200+ years; (2) transformation from power symbols to public spaces; (3) representation of different typologies (gathering places and green spaces); (4) availability of historical documentation.

Yogyakarta cases:

- Alun-Alun Utara (North Square): 250×250m ceremonial square
- Alun-Alun Selatan (South Square): 150×125m royal square

- Embung Langensari: retention pond and urban park (4.2 ha) Jakarta cases:
- Medan Merdeka/Monas: 100-ha national square complex
- Lapangan Banteng: 3.4-ha historical urban park

2.2. Data Collection and Sources

Primary data comprised cartographic materials spanning four periods:

Table 2 *Historical Maps and Data Sources.*

Period	Years	Yogyakarta Sources	Jakarta Sources
I	Pre-1900	Louw (1830), Topographisch Bureau (1872, 1888)	Batavia maps (1880-1895), Bemmelen & Hoover (1897)
II	1900-1945	Jogjakarta en Omstreken (1925), Japanese occupation maps (1946)	Wagner & Debes (1914), Plan of Batavia (1930)
III	1945-2000	Indonesian Survey maps, Municipal plans	DKI Jakarta plans, Aerial photographs
IV	2000-2021	Google Earth, Municipal GIS data	Sentinel imagery, OpenStreetMap

Additional sources included:

- Colonial photograph collections (KITLV, Leiden University) - Historical texts and government documents
- Contemporary ield observations (2021)

2.3. Analytical Framework

Urban morphological analysis employed Kropf's element-based approach, decomposing urban tissue into hierarchical components:

1. Primary elements: Streets, blocks, plots, buildings
2. Natural context: Water bodies, vegetation, topography
3. Temporal layers: Sequential accumulation of forms

2.4. Quantitative Measurements

Four indicators were calculated for each period using GIS analysis:

1. Building Coverage Ratio (BCR) - BCR = (Total building footprint / Study area) × 100%
2. Block Density - Block density = Number of blocks / Area (hectares)
3. Intersection Density - Intersection density = Number of intersections / Area (hectares)
4. Natural Context - Natural context = (Green area + Blue area) / Total area × 100%

2.5. Transformation Cycle Identiication

Following established morphological theory by Conzen, Caniggia & Maffei, transformation phases were identiied through:

1. Institutive: Initial development, low density (BCR <20%)
2. Repletive: Consolidation phase (BCR 20-40%)
3. Climax: Maximum density (BCR >40%)
4. Recessive: Decline or redevelopment

Threshold values were derived from established morphological theory: Conzen's burgage cycle identiies the climax phase when plot subdivision reaches maximum intensity, typically above 40% site coverage. Caniggia & Maffei's territorial development model similarly identiies the 'saturazione' (saturation) phase at comparable density levels. The 20% threshold distinguishing

institutive from repletive phases aligns with Marcus and Colding's spatial resilience indicators, where initial development below this threshold indicates predominantly open or agricultural land use. These thresholds were validated against comparative studies of European historic centres by Kropf and Dibble et al., which report similar density ranges for corresponding morphological phases.

2.6. Persistence Analysis

Element persistence was evaluated through sequential comparison across periods, creating a persistence matrix identifying:

- Persistent elements (unchanged across 3+ periods)
- Modiied elements (partial transformation)
- Lost elements (complete replacement)

2.7. Data Processing and Visualisation

Historical maps were georeferenced using stable reference points (religious buildings, main streets). Missing data was reconstructed through:

- Triangulation of multiple sources
- Historical photograph analysis
- Textual descriptions from contemporary accounts

Visual reconstructions included 2D plan analysis for each period and 3D representations for key transformation areas. Quantitative measurements were derived from scaled historical maps and veriied through cross-referencing multiple sources.

2.8. Limitations

The varying accuracy of historical maps introduces potential uncertainty in quantitative indicators, particularly for BCR and block density calculations in Periods I and II. To address this, we employed conservative estimation protocols: (1) building footprints were calculated only when clearly delineated in maps; (2) ambiguous boundaries were cross-veriied with photographic evidence where available; (3) the margin of error is estimated at ±5-10% for pre1900 data and ±3-5% for post-1900 data based on map scale comparisons. These uncertainties are greatest at the plot and individual building scales, while block- and urban-square-level measurements are more reliable because they are represented across multiple source types.

3. Result and Discussion

3.1. Transformation Cycle

Analysis of transformation cycles identiies how each area undergoes physical development stages: institutive (initial construction), repletive (consolidation), climax (peak density), and recessive (decline/redevelopment).[30, 31, 33, 36]

3.1.1 Gathering Place Yogyakarta: North and South Alun-Alun

The city centre of Yogyakarta, formed in the mid-18th century, features a distinctive two-square setting.[38, 39, 40] 42 The North Alun-Alun (AAU, 250×250m) occupies the northernmost part of the palace complex with the Great Mosque on its west side, while the South Alun-Alun (AAS,

Figure 1. Two-Dimensional Reconstruction of Gathering Place, (left) Alun-Alun Utara (AAU) & (right) Alun-Alun Selatan (AAS)

150×125m) lies within the city walls on the southernmost side.[41]

Period 1 – Institutive & Repletive (1759-1900): The Giyanti Agreement of 1759 initiated Yogyakarta's development on drained swampland between two delected rivers. The squares served ceremonial functions, including garebeg (religious rituals) and watangan (tournaments). Maps from 1830 to 1888 show the AAU block deined by palace, mosque, residential, and ofice blocks, with low-density buildings.[42, 43, 44] The AAS block remained enclosed by the palace, the elephant enclosure, and the residential blocks.

Period 2 – Repletive (1900-1945): Dutch economic liberalisation drove urbanisation. European immigrants settled outside city walls; Asian immigrants concentrated along northern road corridors.[45] Block patterns persisted as building density increased (BCR 4.79%). Signiicantly, vehicle roads now penetrated the AAU, replacing the previous perimeter-only access.[46] The defensive moat transformed into open space following the 1867 earthquake and Japanese occupation.[47]

Period 3 – Climax (1945-2000): Post-independence land reform converted royal use rights into property rights, enabling densiication within city walls.[45] BCR increased to 5.13% (AAU) and 21.40% (AAS). Road patterns bifurcated, dividing AAU into four unequal parts. Public accessibility became unrestricted, transforming ceremonial spaces into daily public areas.

Period 4 – Climax (2000-2021): BCR continued increasing to 9.17%. The road sections dividing AAU were eliminated, restoring spatial unity. Five entry points now connect to a perimeter road. Pedestrian paths with distinct paving materials separate foot and vehicle trafic.

3.1.2 Green Urban Place Yogyakarta: Embung Langensari

Located 4km northeast of the palace, the Embung Langensari area evolved from rice ields through a horse racing arena and a railway workshop to a contemporary mixed-use. The Belik River traverses the area, connecting to the Gajah Wong River 5km southeast.[48]

Period 1 – Institutive (1759-1900): The 1872 map shows predominantly open land and rice ields (BCR 0.52%).[42] Railway construction (Lempuyangan Station, 1873) initiated urban development. The area was lanked by a highway (north) and a railway (south) connecting Yogyakarta, Surakarta, and Semarang.

Period 2 – Repletive (1900-1945): Urban functions emerged with railway workshop blocks, oficers' housing, and a horse-racing arena on the eastern side, and churches and hospitals on the

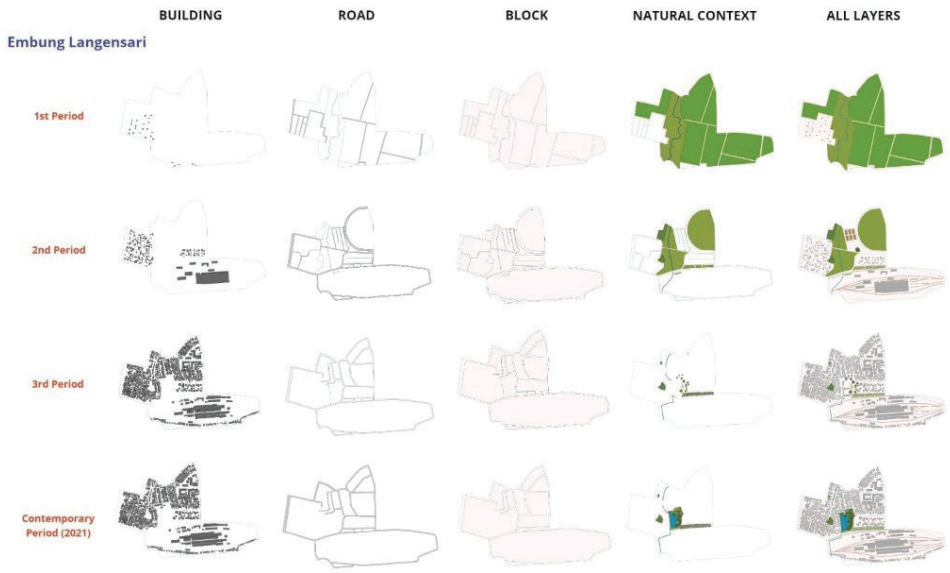

Figure 2 *Two-Dimensional Reconstruction of Green Public Place: Embung Langensari*

western side.[46] Building typology comprised one-storey residential and wide-span workshop structures. BCR reached 32.70% with an intersection density of 0.36.

Period 3 – Climax (1945-2000): Political transitions drastically transformed regional morphology. The racetrack was subdivided into education, ofice, and public facility blocks. Riverbank areas are illed with school buildings. BCR increased rapidly to 48.17%. Railway workshop and employee housing blocks remained persistent.

Period 4 – Recessive & Institutive (2000-2021): Increased looding prompted the government to convert education blocks into retention ponds, integrated with Gadjah Mada University detention ponds upstream. This ecological restoration decreased BCR to 43.42% while increasing green/blue areas—a deliberate return to the institutive phase with enhanced ecological functions.

3.1.3 Gathering Place Jakarta: Medan Merdeka (Monas)

Governor-General Daendels relocated the colonial government centre southward to Weltevreden due to deteriorating ecological conditions in old Batavia.[49] The trapezoidal ield (1000×870m), initially called Koningsplein, was planned for military training in the early 19th century.[50]

Period 1 – Institutive (1809-1900): Surrounding blocks featured *landhuis* typology—multimass residences with extensive gardens. Key buildings emerged progressively: Societeit der Harmoni (1810), Immanuel Church (1835-1839), State Palace (1794/1848), Merdeka Palace (1879), and National Museum (1862-1868).[50] The square featured tropical park vegetation, a pond, and Weltevreden Station.[51] BCR was 11.95% with an intersection density of 0.42.

Period 2 – Repletive (1900-1945): Building density remained stable (BCR 12.26%) while intersection density decreased to 0.34.[52, 53] A horse racing track and police station occupied the square. The annual Gambir Market (1923-1939) showcased colonial technological and architectural achievements.[54] Electric train services connected the area via the Batavia ring route.[55]

Period 3 – Repletive & Climax (1945-2000): Renamed Medan Merdeka, the square underwent nationalist transformation. Ikada Stadium (1951) replaced the racetrack before being dismantled

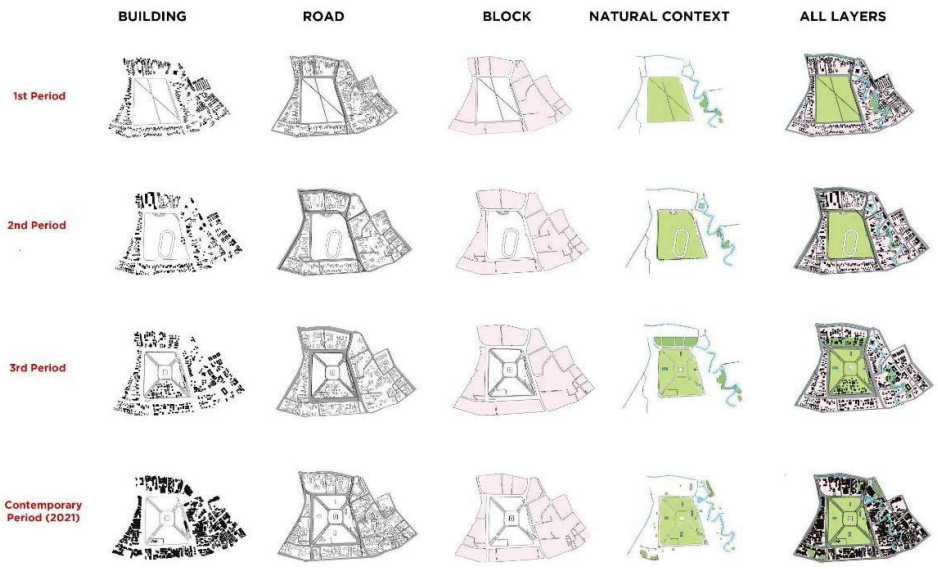

Figure 3 *Two-Dimensional Reconstruction of Gathering Place Medan Merdeka (Monas)*

for the National Monument (132m, completed over 14 years).[56] Cross-roads divided the square into ive thematic blocks.[57] Surrounding landhuisen were replaced by 8-25 storey buildings. Prince Frederik Fortress was demolished to make way for the Istiqlal Mosque Complex.[7] BCR reached 13.94%; intersection density 0.37.

Period 4 – Climax (2000-2021): The 1998 monetary crisis slowed development. The 2010 Cultural Heritage Law introduced conservation considerations.[63] Bus Rapid Transit connected the area to the city networks. BCR increased to 33.24%; intersection density to 0.60.[64]

3.1.4 Green Urban Place Jakarta: Lapangan Banteng

Paradeplaats/Waterlooplein (310×340m) was developed 1809-1828 as the intended government centre and Batavia satellite, connected by main road to old Batavia and Buitenzorg (Bogor).[58]

Period 1 – Institutive & Repletive (1809-1900): The 1880 map shows surrounding government facilities: Gouvernements Hôtel, schools, church, post ofice, Military Club House, Supreme Court, prison, and military hospital.[51] The ield remained open grass with Waterloo and Michiels monuments.[59] BCR was 20.56%; intersection density 0.47. European upper-class gatherings with military band music characterised social functions.[59]

Period 2 – Climax (1900-1945): Building density reached BCR 27.61%; intersection density 0.53.[52, 53] Block functions and road connectivity remained persistent. Tram lines extended from Koningsplein. The Ciliwung River and Waterlooplein open space persisted alongside Wilhelmina and Hertogs parks. Sources document both exclusive European club activities and inclusive indigenous public gatherings.[60]

Period 3 – Recessive & Institutive (1945-2000): Under Sukarno's orders, the square was renamed Lapangan Banteng; colonial monuments were replaced with the West Irian Liberation

Monument.[7] Pedestrian paths enhanced monumentality. Colonial buildings were demolished to make way for the Continental Hotel (now Borobudur) and the Ministry of Religion. Prince Frederik Fortress was transformed into the Istiqlal Mosque Complex. City tram was replaced by bus transit;

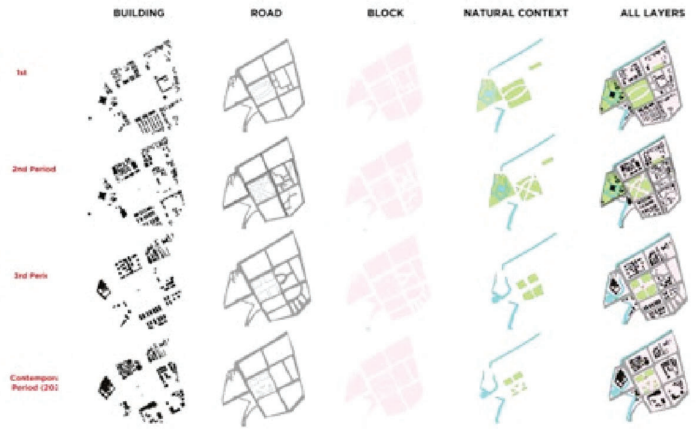

Figure 4 *Two-Dimensional Reconstruction of Green Public Place: Lapangan Banteng*

the square temporarily served as a bus terminal before park restoration. BCR decreased to 20.06%.

Period 4 – Climax (2000-2021): Building compaction continued with government functions dominant. Period-end revitalisation divided the square into monument, park, and sports zones.[61] BCR increased to 31.70%; intersection density decreased to 0.37 due to pedestrianisation.

3.1.5 Synthesis: Transformation Cycle Comparison Cross-case analysis reveals three key patterns:

First, all four cases completed at least one full transformation cycle, with recessive phases consistently brief before transitioning to new institutive phases. This regenerative capacity aligns with Romice et al.'s adaptive cycle model [23], suggesting inherent resilience in Indonesian urban public places.

Second, Jakarta cases exhibit more dramatic phase transitions during Period III, when political transformation triggered extensive morphological changes—such as the demolition of colonial monuments, the construction of nationalist symbols, and the deliberate erasure of colonial spatial identity.

Third, the Yogyakarta cases demonstrate more gradual transitions under consistent Sultanate governance. AAU-AAS maintained climax stability throughout Period IV, whereas Embung Langensari's recessive-to-institutive transition relects ecological adaptation rather than political disruption. Table 3 synthesises transformation phases across all cases:

Table 3 *Transformation Cycle Summary across Case Studies.*

Period	Alun-Alun Utara (AAU) & AlunAlun Selatan(AAS)	Embung Langensari	Medan Merdeka	Lapangan Banteng

I (Pre-1900)	Institutive & Repletive	Institutive	Institutive	Institutive & Repletive
II (1900-1945)	Repletive	Repletive	Repletive	Climax
III (1945-2000)	Climax	Climax	Repletive & Climax	Recessive & Institutive
IV (2000-2021)	Climax	Recessive & Institutive	Climax	Climax

3.2. Persistent Elements and Factors

Persistence analysis identiies urban tissue elements that remained stable, were modiied, or lost during transformation periods. Causal analysis synchronises these patterns with socio-cultural, economic, and ecological factors.[36]

3.2.1 Socio-Cultural Factors

Governance intention emerges as the primary driver of persistence. AAU-AAS's high element persistence correlates with the Sultanate's consistent stewardship across all periods. In Jakarta, changing political actors—from colonial to nationalist governance—encouraged morphological transformation, particularly the deliberate replacement of colonial symbols in Period III.[7] Yet both cities' urban public places evolved into inclusive, democratic spaces that accommodate daily recreation and political demonstrations.

Social structure transformation followed similar trajectories. Jakarta's upper-class European society was replaced by nationalist communities in Period III, evolving into an internationally oriented cosmopolitan society in Period IV.[62] Yogyakarta's exclusive indigenous aristocracy similarly became heterogeneous. This increasing heterogeneity and accessibility across social strata constitute resilience capital.

Cultural events demonstrate differential persistence. Jakarta's public events (Gambir Market, Pekan Raya) receded when relocated to other venues. Yogyakarta's ceremonial traditions (Grebeg, Sekaten) persist at AAU, serving as a continuous cultural function across all periods.

3.2.2 Economic Factors

Jakarta's trade and service economy concentrated ofice functions around Medan Merdeka and Banteng Field, producing a formal spatial character with macro-economic orientation. Annual fairs provided temporary micro-economic representation until their relocation. Yogyakarta's shift from agriculture and plantations (Periods I-II) to education and tourism (Periods III-IV) generated mixed microeconomic activities. The informal sector presence around AAU presents ongoing management challenges for maintaining ceremonial formality.

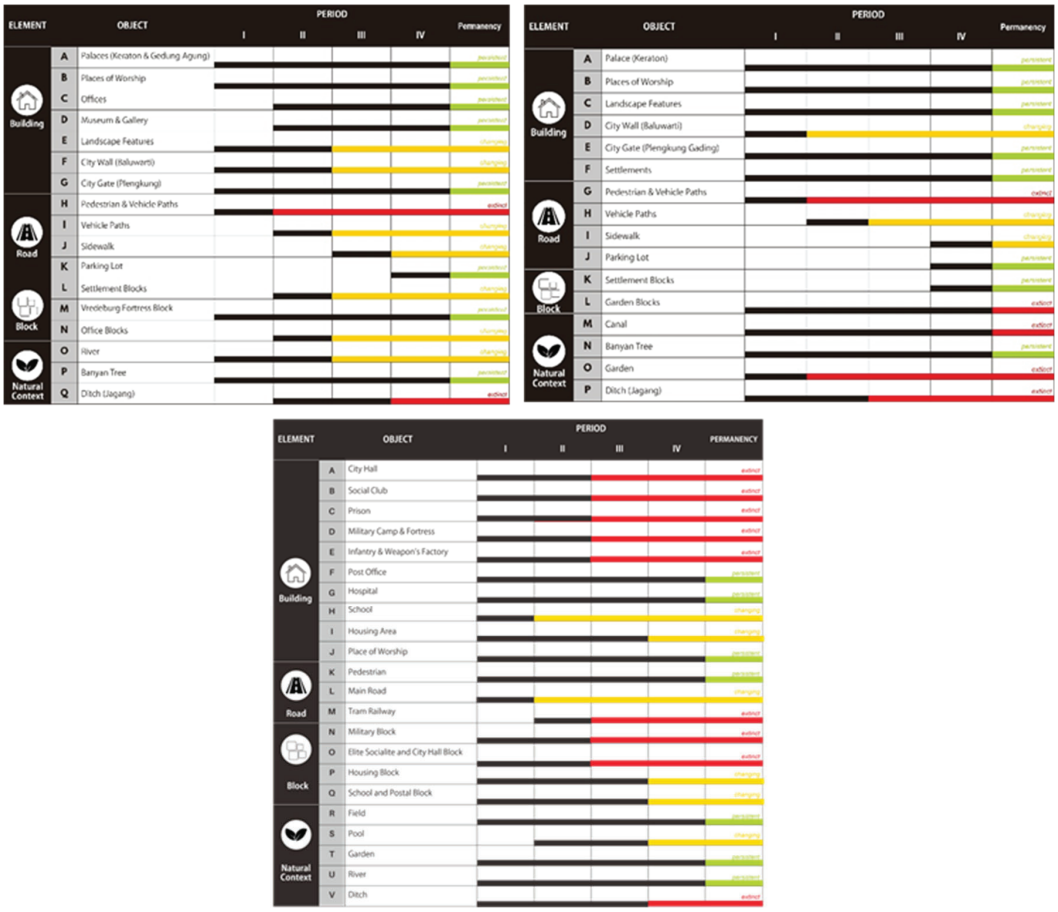

Figure 5 *Diagram of Gathering Place Persistence: North Alun-Alun, South Alun-Alun, and Medan Merdeka (Monas)*

Figure 5 *Green Public Place Persistence Diagram: Embung Langensari and Lapangan Banteng*

3.2.3 Ecological Factors

Both cities developed adaptive responses to distinct environmental challenges. Jakarta's canal systems, sluices, and ponds—unchanged since initial development—address persistent looding. Period III land exploitation intensiied lood vulnerability, prompting renewed ecological prioritisation in subsequent decades. Yogyakarta's earthquake risk prompted traditional height restrictions within city walls, limiting damage from the 1867 and later seismic events. Embung Langensari's Period III land conversion increased lood impact, leading to Period IV ecological restoration through retention pond development integrated with upstream university detention systems.

3.2.4 Synthesis: Persistence Patterns Comparison

Natural context demonstrates the highest persistence across all four cases, followed by street patterns and block structures—conirming Conzenian principles that town-plan elements resist change more than the building fabric.[30, 31, 33, 36] Table 4 presents the persistence matrix:

Table 4 *Element Persistence Matrix across Case Studies*

Element	Alun-Alun Utara (AAU) & AlunAlun Selatan(AAS)	Embung Langensari	Monas	Banteng
Natural Context	High (squares, banyan)	High (Belik River)	High (canals)	High (ield, Ciliwung)
Street Pattern	High	Moderate (railway)	High	High
Block Structure	High	Moderate	Moderate	Moderate
Buildings	High (palace, mosque)	Moderate (workshop)	Moderate (govt.)	Low (most replaced)

3.2.5 Synthesis: Driving Factors Synthesis

Governance continuity determines building persistence: AAU-AAS's Sultanate stewardship maintains high persistence; Jakarta's political transitions triggered deliberate replacement—relecting what Kusno describes as successive layers of political ideology inscribed in urban form.[7] Economic orientation shapes resilience mechanisms: Jakarta's macro-economic focus produces formal spaces with institutional redundancy; Yogyakarta's mixed economy generates small-scale diversity. Ecological infrastructure demonstrates the highest persistence across all cases, conirming natural context as the most stable morphological element and primary resilience anchor.

3.3. Resilience Level

Resilience levels were assessed through four quantitative indicators: building coverage ratio (BCR), block density, intersection density, and natural context ratio.[12, 23, 29] Changes across periods indicate adaptive capacity and transformation trajectories.

3.3.1 Building Coverage Ratio (BCR)

Gathering Places in AAU-AAS showed a modest BCR increase (4.79% to 9.17%), constrained by Sultanate height and density regulations within city walls. Residential and public functions

persisted; mixed functions (commercial, tourism) emerged from Period III. Medan Merdeka increased from 11.95% to 33.24%, with residential functions replaced by government and private ofices. Central government and religious buildings demonstrate the highest physical persistence.

Green Urban Places in Embung Langensari showed a dramatic BCR trajectory—from 0.52% to 48.17% (peak) to 43.42%—relecting a complete transformation cycle, including ecological restoration. The railway workshop and employee housing remained persistent. Banteng Field increased from 20.56% to 31.70%; government and religious functions persisted while residential and military functions were replaced by hotel and public facilities.

3.3.2 Block Density

Block density increased in AAU-AAS (0.06-0.13) and Medan Merdeka (0.08-0.13) as large blocks subdivided. Extreme persistence occurred in AAU-AAS open space, palace, and mosque blocks. Embung Langensari remained stable (0.45-0.42); Banteng Field increased slightly (0.26-0.29), with period-end revitalisation dividing the square into three designated zones.

3.3.3 Intersection Density

Three cases showed increased intersection density, indicating enhanced connectivity: AAU-AAS (0.35-0.60), Embung Langensari (0.25-0.50), and Medan Merdeka (0.42-0.60). Notably, AAU's Period IV road pattern returned to Period I coniguration, eliminating cross-square vehicle routes. Banteng Field decreased (0.47 to 0.37) due to deliberate pedestrianisation consolidating vehicle access points.

3.3.4 Natural Context

Natural context declined universally but with varying magnitude. AAU-AAS and Medan Merdeka decreased from 31% to 22%. Banteng Field showed minimal decline (12.39% to 9.38%). Embung Langensari experienced a severe reduction (78.54% to 6.62%) due to Period III land conversion, though Period IV restoration partially reversed this trajectory through retention pond development.

3.3.5 Synthesis: Quantitative Resilience Comparison

Table 5 presents comparative resilience indicators enabling systematic cross-case analysis, addressing the methodological gap identiied by Liu et al. between descriptive historical approaches and quantitative resilience assessment:[12, 23, 29]

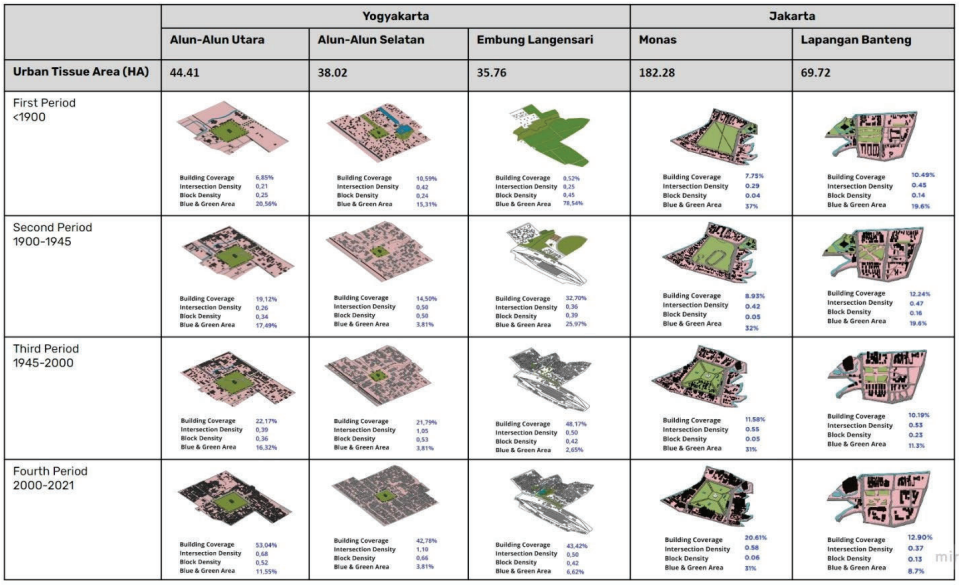

Figure 6 *Three-Dimensional Reconstruction of Urban Public Places*

Table 5 *Resilience Indicators: Period I vs Period IV Comparison*

Indicator	Alun-Alun Utara (AAU) & AlunAlun Selatan(AAS)	Embung Langensari	Monas	Banteng
BCR (P1 → P4)	4.79% → 9.17%	0.52% → 43.42%	11.95% → 33.24%	20.56% → 31.70%
BCR Change	+4.38%	+42.90%	+21.29%	+11.14%
Block Density (P1 → P4)	0.06 → 0.13	0.45 → 0.42	0.08 → 0.13	0.26 → 0.29
Intersection Density (P1 → P4)	0.35 → 0.60	0.25 → 0.50	0.42 → 0.60	0.47 → 0.37
Natural Context (P1 → P4)	31% → 22%	78.54% → 6.62%	31% → 22%	12.39% → 9.38%
Natural Context Change	-9%	-71.92%	-9%	-3.01%

3.3.6 Synthesis: Interpretation of Resilience Patterns

BCR patterns relect governance and regulatory contexts: AAU-AAS's minimal increase (+4.38%) results from Sultanate restrictions; Jakarta cases show moderate densiication (+16.2% average) in government-designated areas; Embung Langensari's dramatic trajectory (+42.90%) represents a complete cycle, including ecological reversal.

Connectivity generally increased, indicating enhanced spatial integration. Banteng Field's decrease (-0.10) relects a deliberate design choice—pedestrianisation prioritising public space quality over vehicular access.

Natural context decline is universal, but its magnitude and reversibility vary dramatically. Embung Langensari's severe reduction (-71.92%) was partially reversed through deliberate ecological restoration—demonstrating cyclical recovery potential that distinguishes Southeast Asian cases from linear decline trajectories observed in comparable studies.[29]

3.4. Positioning within International Comparative Studies

These indings align with and extend international comparative studies on urban morphological resilience, while revealing distinctive patterns in Southeast Asian postcolonial contexts.

3.4.1 Comparison with European cases

Anderson's study of Wenceslas Square in Prague identiied natural context and street patterns as highly persistent elements across political transitions from the Habsburg period through the communist and post-communist periods.[25] However, while Anderson found commercial functions drove transformation cycles in European contexts, the Jakarta-Yogyakarta comparison reveals that *governmental intention* serves as the primary persistence factor in postcolonial Southeast Asian cities—relecting the stronger role of state intervention in shaping urban morphology in former colonial territories.

3.4.2 Diversity-resilience relationship

Le Fort and De Visscher's study of Brussels demonstrated that typomorphological diversity correlates with adaptive capacity at the block scale.[21] The present indings corroborate this relationship: higher functional diversity in Medan Merdeka and Banteng Field (government, commercial, religious) corresponds with the capacity to absorb dramatic political transformations. Conversely, AAU-AAS's relatively homogeneous residential function exhibits a *different resilience mechanism*—persistence through institutional continuity rather than functional diversity.

3.4.3 Comparison with Chinese urbanisation

Liu et al.'s quantitative assessment of Shenyang found natural context indicators declined signiicantly during rapid urbanisation, with limited recovery potential.[29] The present data reveal a parallel decline pattern. However, Embung Langensari demonstrates that Southeast Asian cities may exhibit *cyclical recovery* through deliberate ecological restoration—a pattern not observed in Chinese cases, suggesting the urbanisation-ecological degradation relationship may be less deterministic in Indonesian contexts.

3.4.4 Methodological validation

Hanzl and Kowalski's integration of burgage cycle analysis with morphometric assessment provides methodological validation for the present approach.[27] Their inding that plot-level persistence exceeds building-level persistence aligns with AAU-AAS observations, where traditional plot boundaries remained stable despite building replacement. This suggests that Conzenian morphological principles are applicable in Southeast Asian postcolonial contexts, with appropriate contextual adaptation to traditional governance structures and symbolic continuity.

3.4.5 Theoretical implications

These cross-cultural comparisons suggest urban morphological resilience operates through context-dependent mechanisms. While European studies emphasise functional diversity and

market-driven adaptation, and Chinese studies document linear ecological decline under rapid state-led development, Indonesian cases reveal a third pattern: resilience through *governance continuity and cyclical ecological adaptation*. This contributes to the recognition that urban resilience frameworks require calibration to speciic socio-political and cultural contexts, particularly in postcolonial settings where traditional institutions continue to shape urban form.[23, 28, 29]

4. Conclusion

There is a transformation cycle in the four research cases; it can be identiied that the four cycle stages (institutive, repletive, climax, recessive) have been passed. There is a similarity in that the recessive period in the four cases is short-lived and is immediately followed by new functions and types. Physically, the persistence of each element of the AAU-AAS area is relatively higher than the Banteng Field and Medan Merdeka, with the maintenance of the intention to maintain the persistence of the character of the AAU-AAS Area. With elements of the area that are persistent in the natural context, such as greening pockets and squares. Persistent elements in Medan Merdeka Square (Monas) are several buildings, building blocks, and natural contexts. Buildings include ofices, museums, educational facilities, and health facilities. Building blocks are in government and trade blocks; the natural context is crosswalk islands. The Langensari Reservoir maintains a sense of place through the road, building blocks, and natural context. Persistent street spaces are railway workshops, collector roads, and sidewalks. The persistent building blocks of the Embung Langensari area are oficial houses, and then natural elements such as rivers and embankments. Meanwhile, the elements that persist in the Banteng Field Area are buildings, roads, and the natural context. Persistent buildings in the Banteng Field area are post ofices and hospitals; roads are pedestrian ways; and the natural context is ields, parks, and rivers.

There is a study on resilience levels; each element of the region studied has a high level of resilience. North Alun-Alun (AAU) & South Alun-Alun (AAS), Medan Merdeka Area (Monas), Embung Langensari, and Banteng Field showed increased resilience at the end of the period in the *building coverage Ratio* (BCR), *block density, and intersection density*. At the same time, the *natural context* in each area declined. In general, by paying attention to the principles of resilience of urban form and urban ecology. The four cases have positive values, indicating the development of the four regions in line with the principle of resilient urban public places. The resilience factors of urban public places are strongly inluenced by the persistence of the area's main elements, not solely by the persistence of the urban square shape as the area's main block. In fact, Medan Merdeka, Banteng Square, and Embung Langensari have undergone many transformations. However, the area's general character has largely survived.

A limitation of the study is the inconsistency in map details between locations and across periods, where it is rare for mapping to be detailed down to the plot level. Some maps often depict only the level of blocks and roads, so reconstruction requires interpretation from other sources, such as photos or historical texts. In all four cases, the transformation cycle differs within each block within the region. Given its nature as a preliminary, comparative study, this study limits itself to comparable blocks. Further research is highly recommended to enrich the study of urban public place resilience by examining each case in depth and quantitatively. A partial study that focuses on a more detailed picture at the building, plot, and function levels will enrich the study of urban public place resilience.

These indings offer actionable guidance for urban planners working in postcolonial Southeast Asian contexts:

1) Prioritise Natural Context Preservation: Given natural context's highest persistence across all cases, planning policies should protect water bodies, vegetation, and topographical features as primary resilience anchors. Jakarta's canal system and Yogyakarta's anyan trees exemplify how persistent natural elements provide continuity across transformation cycles.
2) Adaptive Density Management: The transformation cycle analysis suggests that recessive phases, when properly managed, can initiate new institutive cycles (as demonstrated in Embung Langensari). Planners should view declining areas not as failures but as opportunities for ecological restoration and functional renewal.
3) Block Structure as Resilience Framework: The persistence of block patterns, even when individual buildings change, suggests that maintaining clear block deinitions and street networks provides structural resilience. New development should respect existing block boundaries while allowing internal lexibility.
4) Governance Consistency Matters: AAU-AAS's higher element persistence compared to Jakarta cases correlates with the Sultanate's consistent stewardship. This suggests that long-term institutional commitment to spatial identity enhances morphological resilience, a consideration for heritage governance frameworks.

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References

[1] Kostof S 1992 *The City Assembled: The Elements of Urban Form Through History* (London: Bulinch Press)
[2] Ching F D K, Jarzombek M and Prakash V 2011 *A Global History of Architecture* 2nd edn (Hoboken: Wiley)
[3] Oliveira V 2016 *Urban Morphology: An Introduction to the Study of the Physical Form of Cities* 1st edn (Cham: Springer) (doi: https://10.1007/978-3-319-32083-0)
[4] Whitehand J W R 2001 *Urban Morphology* **5** 103–9 (https://doi.org/10.51347/jum.v5i2.3896)
[5] Kropf K S 2017 Bridging conigurational and urban tissue analysis *Proc. 11th Space Syntax Symposium* (Lisbon) p 14
[6] Cataldi G, Maffei G L and Vaccaro P 2002 Saverio Muratori and the Italian school of planning typology *Urban Morphology* **6** 3–14

[7] Kusno A 2014 *Behind the Postcolonial: Architecture, Urban Space and Political Cultures in Indonesia* (Abingdon: Routledge) [8] King A D 1976 *Colonial Urban Development: Culture, Social Power and Environment* (London: Routledge) [9] Bishop R, Phillips J and Yeo W-W (ed) 2003 *Postcolonial Urbanism: Southeast Asian Cities and Global Processes* (New York: Routledge)
[10] da Silva J and Morera B E 2014 *City Resilience Framework City Resilience Index* (London: Arup)
[11] Meerow S, Newell J P and Stults M 2016 Deining urban resilience: a review *Landsc. Urban Plan.* **147** 38–49
[12] Feliciotti A, Romice O and Porta S 2016 Design for change: ive proxies for resilience in the urban form *Open House Int.* **41** 23–30
[13] Marcus L and Colding J 2014 Toward an integrated theory of spatial morphology and resilient urban systems *Ecol. Soc.* **19** 55
[14] McGee T 2022 T. McGee on Desakota *The Horizontal Metropolis* ed M Barcelloni Corte and P Viganò (Cham: Springer)
[15] Evers H-D and Korff R 2003 *Southeast Asian Urbanism: The Meaning and Power of Social Space* 2nd edn (Munster: Lit Verlag)
[16] Evers H-D 2011 Urban symbolism and the new urbanism of Indonesia *Cities Full of Symbols. A Theory of Urban Space and Culture* ed P J M Nas (Leiden: Leiden University Press)
[17] Carmona M 2021 *Public Places Urban Spaces: The Dimensions of Urban Design* 3rd edn (Abingdon: Routledge)
[18] Bentley I (ed) 1987 *Responsive Environments: A Manual for Designers* (London: Architectural Press)
[19] Evans J P 2011 Resilience, ecology and adaptation in the experimental city *Trans. Inst. Br. Geogr.* **36** 223–37
[20] Haughton G and Hunter C 2006 *Sustainable Cities* (Abingdon: Routledge)
[21] Le Fort B and De Visscher J-P 2019 Typo-morphological diversity and urban resilience: a comparative study of three heterogeneous blocks in Brussels *Urban Morphology* **24** 1
[22] Frey H 1999 *Designing the City: Towards a More Sustainable Urban Form* (London: E & FN Spon)
[23] Romice O, Porta S and Feliciotti A 2020 *Masterplanning for Change: Designing the Resilient City* (London: RIBA Publishing)
[24] Rossi A 1982 *The Architecture of the City* (Cambridge, MA: MIT Press)
[25] Anderson C E 2011 Resilience in an urban social space: a case study of Wenceslas Square Master Thesis The Ohio State University
[26] Dibble J et al 2019 On the origin of spaces: morphometric foundations of urban form evolution *Environ. Plan. B* **46** 707–30
[27] Hanzl M and Kowalski K 2021 Resilient urban form assessment – burgage cycle and morphometry *Computational Science and Its Applications – ICCSA 2021* ed O Gervasi et al (Springer) pp 493–508
[28] Feliciotti A, Romice O and Porta S 2018 From system ecology to urban morphology: towards a theory of urban form resilience *Proc. IFoU 2018: Reframing Urban Resilience Implementation* (MDPI) 5993
[29] Liu Z, Xiu C and Song W 2019 Landscape-based assessment of urban resilience and its evolution: a case study of the central city of Shenyang *Sustainability* **11** 2964
[30] Conzen M R G 1960 Alnwick, Northumberland: a study in town-plan analysis *Trans. Pap. (Inst. Br. Geogr.)* **27** iii–122

[31] Caniggia G and Maffei G L 1979 *Composizione Architettonica e Tipologia Edilizia, 1. Lettura Dell'Edilizia Di Base* (Venice: Marsilio) [32] Caniggia G and Maffei G L 1984 *Composizione Architettonica e Tipologia Edilizia. 2. Il Progetto Nell'edilizia Di Base* (Venice: Marsilio)
[33] Price M F 2003 Panarchy: understanding transformations in human and natural systems *Biol. Conserv.* **114** 2
[34] Hustwit G (dir.) 2011 *Urbanized* [Documentary]
[35] Dogar M I and AÁlvarez G 2024 *United Nations Human Settlements Programme Background Guide 2024* (UN-Habitat)
[36] Kropf K 2017 *The Handbook of Urban Morphology* (Hoboken: John Wiley & Sons)
[37] London K and Ostwald M 2013 Architectural research methods *Nexus Netw. J.* **6** 1
[38] Santoso J 2008 *Arsitektur-Kota Jawa: Kosmos, Kultur & Kuasa* (Jakarta: Centropolis)
[39] Ikaputra 1995 A study on the contemporary utilization of the Javanese urban heritage and its effect on historicity Doctoral Thesis Osaka University
[40] Lombard D 1996 *Nusa Jawa: Silang Budaya; Kajian Sejarah Terpadu. Bag. 3: Warisan Kerajaankerajaan Konsentris* (Jakarta: Gramedia)
[41] Sunaryo R G et al 2013 Colonial and traditional urban space in Java: a morphological study of ten cities *Dimensi (J. Archit. Built Environ.)* **40** 77–88
[42] *Kaart van de Hoofdplaats Djokjakarta En Omstreken* 1872 (Topographisch Bureau) [43] Louw P J F n.d. *Platte Grond van de Hoofdplaats Jogjakarta Omsteeks 1830* (Landsdrukkerij) [44] *Plattegrond van Den Ganschen Benteng Kraton Te Jogjakarta in Zijn Vollen Omvang* 1888 (G P Rouffaer)
[45] Subhekti Y I 2005 Perkembangan Tamansari sebagai kawasan konservasi dan pariwisata Kota Yogyakarta MSc Thesis Universitas Diponegoro
[46] *Jogjakarta en Omstreken* 1925 (Topograische dienst in Nederlandsch-Indië)
[47] Hadiningrat K N 2017 Benteng Keraton Yogyakarta Preprint
[48] Suprayogi S, Fatchurohman H and Widyastuti M 2019 Analisis kondisi hidrologi terhadap perkembangan wilayah perkotaan *Jurnal Geograi* **16** 153–61
[49] Handinoto 2008 Daendels dan perkembangan arsitektur di Hindia Belanda abad 19 *DIMENSI (Jurnal Teknik Arsitektur)* **36** 43–53
[50] Sunaryo R G 2015 Morfologi ruang pusat kota Jawa periode kolonial Doctoral Thesis Universitas Gadjah Mada
[51] Batavia (1880–1895) 1925 *Souvenir Aan Het Topographisch Bureau Te Batavia* (Batavia: Topographisch bureau te Batavia)
[52] Wagner H and Debes E 1914 *Batavia [Jakarta] 1914* (Verlag von Karl Baedeker)
[53] *Plan of Batavia [ca. 1930]* 1930 (Oficiële Vereeniging voor Toeristenverkeer in Nederlandsch Indië)
[54] Handinoto n.d. Pasar Gambir
[55] PT Kereta Kommuter Indonesia 2017 Sekilas PT Kereta Commuter Indonesia: menuju 100 tahun KRL Jabodetabek
[56] Lapangan Ikada 2022 *Wikipedia* 13 April
[57] Monumen Nasional 2022 *Wikipedia* 30 April
[58] Bemmelen J F van and Hoover G B 1897 *Batavia [Jakarta] 1897. Guide to the Dutch East Indies* (London: Luzac & Co)
[59] Reenen M 2005 Daendels' getemperde ambities: een architectuurhistorische analyse van het Gouvernements Hôtel in Weltevreden (het huidige Jakarta) *Bulletin-KNOB* 2005

[60] Wibowo A 2012 Gaya hidup masyarakat Eropa di Batavia pada masa depresi ekonomi (1930–1939) Thesis Universitas Indonesia
[61] Ravel S 2018 Wajah baru Lapangan Banteng diharapkan singkirkan citra negatif masa lalu *Kompas.com* (Jakarta) 12 July
[62] Widodo J 2014 Jakarta – the great Asian cosmopolitan city *Proc. Jak_A2014* ed C Puspitasari and D Anggita (Pancasila University)
[63] Setiap Gedung Punya Cerita 2022 Blog sejarah gedung-gedung Indonesia 9 March
[64] PT Kereta Api Indonesia 2017 Stasiun Gambir (heritage.kai.id)