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RIGA TECHNICAL UNIVERSITY
Architecture and Urban Planning
2022, Vol. 18, Issue 1, pp. 43–56
https://doi.org/10.2478/aup-2022-0005
https://content.sciendo.com
Online ISSN 2255-8764

Urban Form and the Role of Urban Morphological Characters in Town-Plan Regionalization: A Systematic Review

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Received 2022-01-20; accepted 2022-07-14

Keywords

Built form, emergence and evolution, morphological characters, morphological region, urban form.

Abstract

Urban morphological characters have implications for town-plan regionalization but have received little attention. This paper systematically reviewed urban form aspects, built form and morphological characters. The review highlighted built form is a reference aspect that coordinates other aspects of urban form and contains hierarchical plan-element complexes. Such complex relationship within the built form is vital to give urban form its morphological characters. Since urban morphological characters regionalize town plans, this role merits more study to establish relationships among morphological characters, town-plan regions, and sustainable development. There is also a shift to study town-plan regionalization in support of urban landscape management.

Introduction

Urban form is among the misunderstood concepts in urban morphology because it is seen as constituting only an urban area's physical or built elements on one hand [1], [2], [3] and as comprising physical and non-physical features on the other hand [4], [5]. In addition to this reason, the concept is considered synonymous with urban morphology in some quarters [6], [7], [8]. Poon et al. [3], for example, mentioned explicitly that urban form appears complex and contains several physical components. This definition tends to limit its usage, thereby ignoring its complexity. Therefore, this concept's view of comprising both physical and non-physical constituents presents a more adequate basis for understanding urban form.

Regarding this, Kropf [4] provided three broad categories (based on spatial, human-spatial, and temporal relations) in which eleven urban form aspects reside (see Section II). Among the fundamental urban form aspects is the built form, which constitutes the physical features and is also called the built environment [9], [4]. Also, it is considered a reference aspect that coordinates the other aspects [4]. Since several morphological characters appear within the built form, they play an important role in town-plan regionalization. They are patterns that define the built form and present its unique nature. However, their emergence and evolution, and how they shape the town plan into regions have received little attention in urban morphology. Urban morphological characters are the built form's important features. Understanding how they emerge and evolve has implications for regionalizing the town plan.

Therefore, this paper aims to systematically review how urban morphological characters emerge and evolve and their role in town-plan regionalization. Answers to the following questions will help to achieve this aim: (1) What are the aspects of urban form, and why is the built form significant? (2) What are the built form components, and how do they describe its morphological characters? (3) What distinct morphological characters emerge and evolve when these components interact? (4) What is the future agenda on urban form research?

Subsequently, Section I describes the method: systematic literature review. Sections II–IV are the qualitative synthesis: (1) urban form aspects; (2) built form and its significance as a reference aspect; and (3) morphological characters and their emergence and

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evolution in built form, respectively. While Section V discusses the role of urban morphological characters in town-plan regionalization, the final section provides the conclusion and future research agenda.

I. Method

A. Systematic Literature Review Process

This study employed a systematic literature review process as illustrated in Figure 1 (Fig. 1). This approach involved four stages (identification, screening, assessment and inclusion) based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [10]. Firstly, in the identification stage, a search was conducted utilizing a broad topic and the Boolean operators as follows: "urban form" OR "urban morphology" search by article title and publication date from 1 January 2015 to 22 September 2020 in Scopus and Web of Science (WoS) databases. This returned 1059 research and review articles (n = 559 from Scopus and n = 500 from WoS), which were then further limited by keyword search within the results.

The keywords employed were "aspect*" (n = 181), "built form" OR "built landscape" OR "physical landscape" OR "physical form" OR "spatial form" OR "built environment" (n = 387), "morphological characters" OR "morphological character areas" OR "morphog*" (n = 13), "town plan" OR "ground plan" OR "town-plan element*" OR "ground-plan element*" (n = 32), "urban landscape" OR "townscape" AND "town plan" AND "building fabric" AND "land and building utilization" OR "land use" (n = 158), and "morphological region*" OR "town-plan region*" (n = 101). Overall, this stage returned 550 and 322 articles from Scopus and WoS, respectively, to provide a total of n = 872 articles.

Secondly, the screening stage involved the duplicate removal and screening of articles. After duplicate removal, 436 articles were included. Furthermore, these articles were screened considering their titles' relevance and abstract information. Therefore, 248 articles were included while 188 were excluded.

In the third stage, the 248 full-text articles were assessed based on their relevance and contribution to this study, and 160 full-text articles were excluded for not meeting the eligibility criteria. These criteria were: (1) relevance to the topic "built form" in the urban form or urban morphology context; (2) relevance to the topic "urban morphological characters" in the built form context and its components; (3) full-text article accessibility; and (4) full-text article in Scopus or WoS indexed sources. Finally, 88 articles were included in this qualitative synthesis.

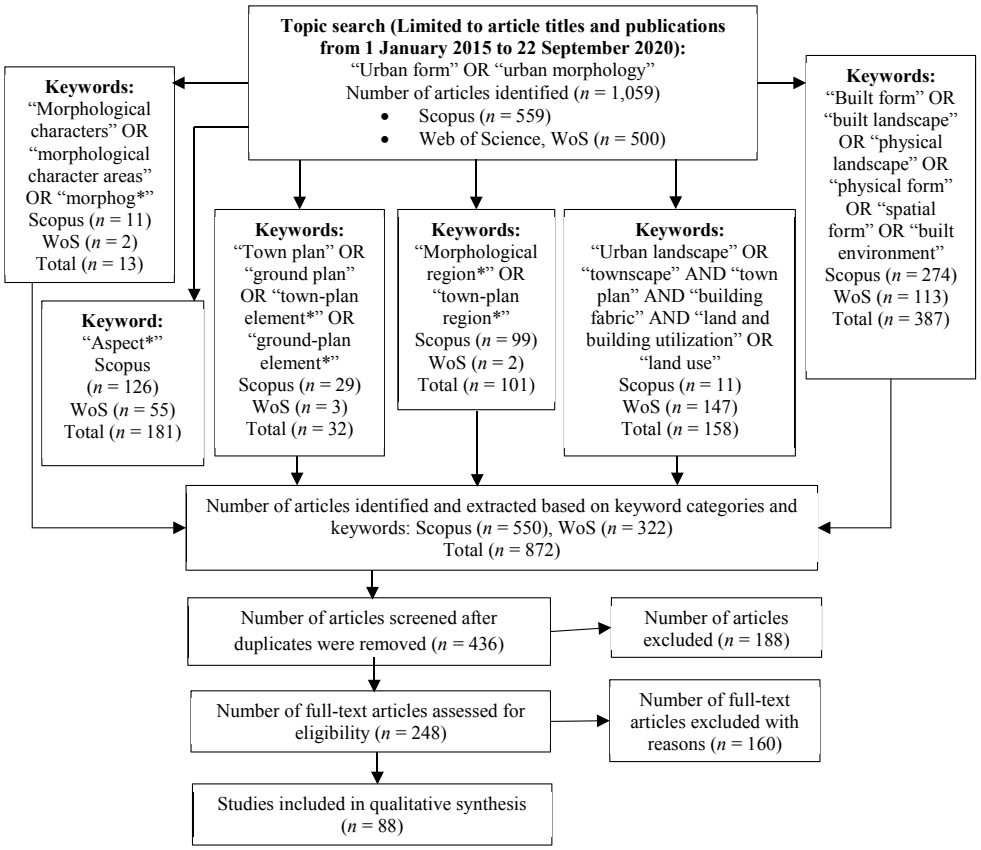

Fig. 1. Stages of the systematic literature review protocol [developed by authors].

B. Keyword Occurrence

Figure 2 shows the article distribution by keyword occurrence. The urban form had the highest occurrences of the 88 articles reviewed. It was sometimes interchanged with urban morphology. The built environment (mostly interchanged with "built form," "built landscape," "physical form," or "spatial form") had the next highest occurrence with about 70 articles. However, keywords like morphological characters and morphological regions or regionalization showed the lowest occurrence with less than 5 articles each.

Figure 3 shows the frequency of keyword occurrence in articles by year. The urban form occurrence frequency rose from about 100 in 2015 to approximately 1300 in 2019 and reached 1200 in 2020. Also, urban morphology and the built environment exhibited similar patterns. The urban morphology occurrence frequency rose from 41 in 2015 to 255 in 2019 and attained 216 in 2020. For the built environment, it increased from 42 in 2015 to 361 in 2019 and achieved 82 in 2020. Although Figure 3 indicates a drop in some keyword occurrences in 2020, as mentioned above, it only applied to data from January to September. However, other keyword occurrences indicated little or no changes, which were all below 200 from 2015 to 2020. Morphological characters and morphological regions or regionalization, in particular, showed very low occurrence or even non-existence during these years.

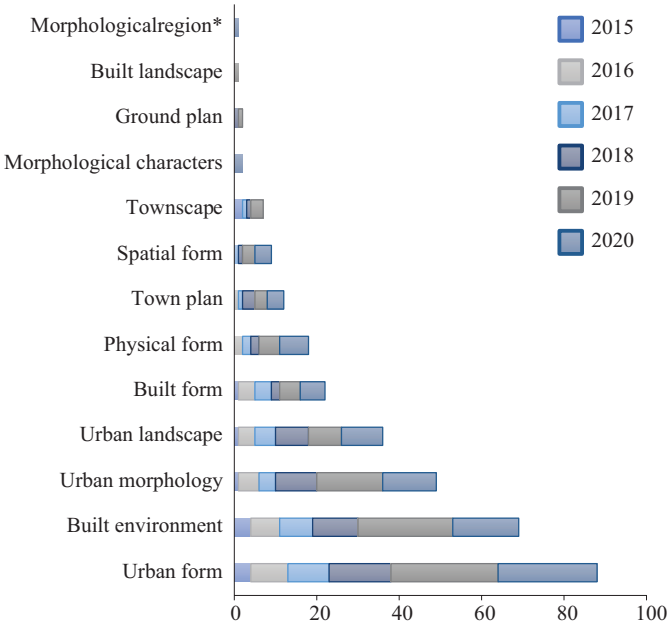

Fig. 2. Distribution of reviewed articles by keyword occurrence [developed by authors].

II. Urban Form Aspects

This paper focuses on the notion that urban form constitutes both physical and non-physical elements. Some studies, for example, Bielik et al. [11] and Dibble et al. [12], expressed this notion. Considering this notion, Kropf [4] gives a comprehensive list of the urban form aspects. Therefore, this list is utilized as the organizing principle in this section. Eleven aspects are identified based on three relation types: physical constituents' spatial relations (spatial aspects), human-physical constituent interrelations (spatiotemporal aspects), and temporal relations or temporal aspects [4], [13].

C. Spatial Aspects

Based on physical constituents' spatial relations, the site or natural environment and built form are considered urban form aspects. While the unaltered physical element combinations forming a place and their relationship patterns belong to the natural environment and can be

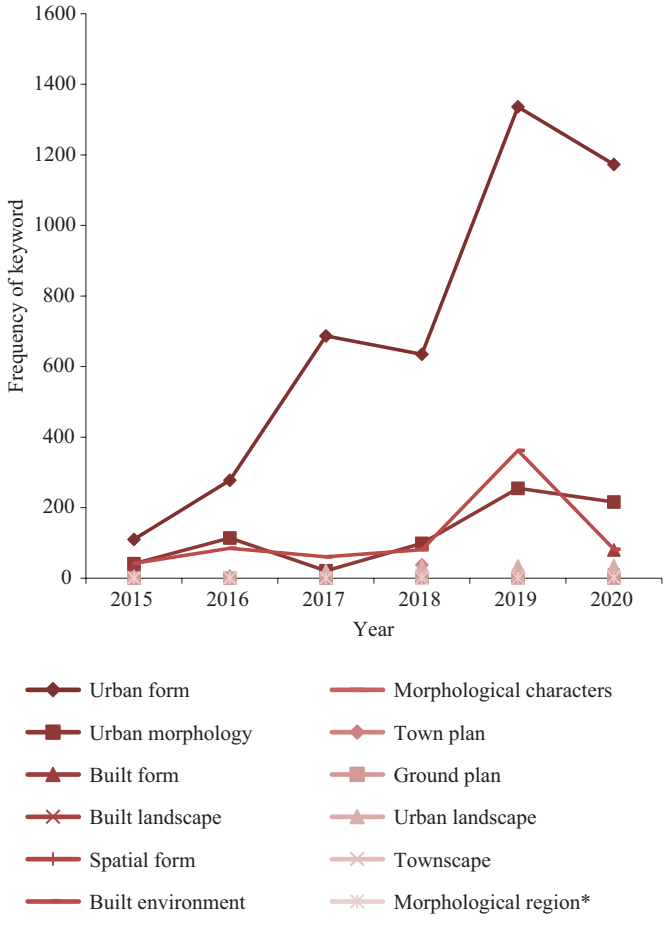

Fig. 3. Frequency of keyword occurrence by year from 2015 to 2020 in the reviewed articles [developed by authors].

viewed as a built form substrate [4], [13], the human-transformed physical elements embedded in the natural environment and their relationships comprise the built form [4], [13], [14]. This review reveals some studies that consider these aspects together with or separate from other aspects.

1. Site or Natural Environment: The natural environment is the unavoidable setting from which urban form is essentially shaped; urban form tends to emerge and evolve when the natural environment is transformed in response to certain conditions in a specific locality [13]. The elements that make up the natural environment fall into geological, topographical, hydrological, biological and climatic categories [4], [15]. These elements form the starting point for analysing the urban form. However, these elements do not exist in isolation. Green space, for example, is provided in many cities to play an important role in maximizing the benefits of urban living while minimizing its negative effects; these natural urban areas can provide ecosystem services such as carbon sequestration, aesthetic pleasure, flood mitigation and on-site pollination [16].

2. Built Form: This belongs to the urban landscape [17] that Conzen [18] referred earlier to as the townscape. Town plans, land-use patterns and building fabrics comprise the urban landscape [15], [19]. As the town plan is subdivided into plan-element complexes (street system, lot pattern and building pattern) [13], [20], the basic built form elements are the streets, lots, buildings and open spaces [14], [21]. Certain studies appear to use urban form instead of built form [22], [23], which creates ambiguity [14] in understanding the two terms. The built form remains this review's fulcrum because it is the reference aspect that connects all other aspects as discussed in Section III.

D. Spatio-Temporal Aspects

Based on interrelations between human and physical constituents, six aspects are identified:

1. Activity, Function, or Use: Function or use refers to people's activities that give rise to and are accommodated by certain built landscape constituents. This can occur in two ways: occupation and movement [4]. Garnica-Monroy and Alvanides [24] undertook a study aimed at investigating spatial accessibility index potential that will benefit the greater resident population in Mexican cities. The study on spatial accessibility was based on research that touched on the two concepts (occupation and movement) under the function or use aspect. Spatial accessibility is the physical access measured from the residences' locations to public goods and service destinations [24].

2. Sociocultural and Economic Context, or Local Culture: This is the way various functions and activities interact and are combined over a broader area [13]. To understand urban form and apply it judiciously, a study has to be positioned in a definite context to clearly describe, explain and apply the issues associated with its aspects [4]. For example, in the research by Hosni and Zumelzu [25], an empirical case study was undertaken to evaluate the public spaces' quality based on the users' perceptions. The study used the nodal concept as a sustainable urban form dimension defined by its size, level and type [25] to arrive at a new perspective for better design. This aspect entails recognizing the tenets, notions and intentions of the larger population and the ensuing cultural behaviours, structures and technology that they produce [4], [26].

3. Control: This involves a link between individuals or groups and a land area [4]. This relationship occurs due to full or partial ownership, which could be either by social convention or physical occupation [4], [13]. Control has legal precedents in the land tenure system, which can be in the form of leasehold, occupation, total ownership, regulation or sovereignty [4]. The land tenure system has a connection with the lot system [27]. This aspect has played a vital role in shaping the urban form as it emerges and evolves over time.

4. Intention or Design: This aspect is interlinked with control. The type and degree of control [4] play important roles in determining what goes on the land, thereby influencing the building designs or features in the urban area. "Design features are related to how pleasant the urban environment is, thus indicating the potential for using soft modes instead of motorized ones" [28, *359*]. While socioeconomic, political and psychological changes influence the environment, the physical spatial features are produced through design and planning processes [29]. This aspect has diverse connotations, as the urban morphology field is interdisciplinary in nature [30]. Intention or design cuts across different fields depending on the context scale, detail and resolution level expressed. To challenge the existing spatial and social conventions, openness, transparency, interconnection and mobility infuse design [29]. When any urban feature design is finalized, its actualization through construction is next.

5. Construction: This is the design implementation process to realize the physical features [4], [13]. According to Kropf [13, *116*], construction is about "modifying or constructing a built form". Subject to how elaborate and complex the cultural context is, the construction process can cover some steps, with each presenting possible conditions and limits for built form formation [4]. Having assumed land control, decided on the intention and finalized the design for a project, the next actions may involve statutory approval,

resource acquisition and the construction process [4]. This aspect plays a vital role in the urban form's emergence and evolution because it is the most noticeable process involved in modifying the built form.

6. Perception: Another aspect that has received research attention in recent times is perception. This is the psychological and physiological experience or reaction of being in an area and the sense or image retained in memory [13]. Perception feedback, as the fundamental relationship between human and physical features, enables humans' interaction with the environment, resulting in adaptive behaviour [4]. In his work, Lynch [31] sets the tone for research into this aspect. He mentioned that "most often, our perception of the city is not sustained, but rather partial, fragmentary, and mixed with other concerns". "Nearly every sense is in operation, and the image is the composite of them all" [31, *2*]. After Lynch's seminal work, several works on perception and cognition in the built environment were undertaken. For example, the relationship between public spaces and users' perceptions has been evaluated [25]. Studies on perception can loosely be categorized into "cognition, city image and memory, emotional effect, and interpretation and meaning" [4, *32*].

E. Temporal Aspects

Temporal relations are short-term recurring changes in activity patterns as well as long-term natural and built environment transformations that are primarily described using multiple points in time [13], [32], [33]. Based on these, three aspects [4], [30] are identified:

1. Natural Resource Flows include daylight [34], energy [2], air and its quality or movement [35], [36], the water system [37] and solar radiation [38]. While the natural environment settings essentially extend to the global positioning system and the earth's movement within the solar system, several likely energy sources can be recapped in relation to an energy account, including direct solar and geothermal energy sources, which generate the resultant hydrological cycle, wind and tidal energy types from a local standpoint [4]. This aspect, along with human-induced resource flows, plays a temporal role in shaping the built form, and vice versa.

2. Human-Induced Resource Flows have to do with information, goods, energy and waste movement [13], [39]. It is crucial to fully recognize that the built environment's existence depends on steady human resource flows [4]. Humans design the built form to influence certain indicators like building type, density, neighbourhood layout and landscape elements [40] to control resource flows for climatic control [41]. It is important to note that this aspect is intertwined with all other aspects because human metabolic energy is the primary energy source for producing, maintaining and using the built environment [4], [28].

3. Evolution, Changes, and Historical Development aspect connects all other aspects to time [4], [13], [30] and gives room for contributions from old built form, which have been seen as a reference for fresh interventions in the contemporary urban context [42]. Research in this aspect considers elements and their formation and transformation within the built form over time. Investigation into the relationship between built form expansion and the residential space formation process in a particular context [43], city centre transformation process analysis [44], and neighbourhood typology definition and their transformation over time [45] are studies related to this aspect. Other examples are studies on the urban landscape shaping process under various sociocultural and economic systems [46] and polycentric development's goals and realities with insight into a new urban form [47].

Having described the eleven urban form aspects, Kropf [4] outlined that researchers should employ these aspects as features to describe various places. Every location is unique and has a distinct blend of the various aspects, which may imply that only certain aspects will be applicable in any given context. In most cases, socioeconomic context, historical development and perception supplement the key aspects – the natural environment, built form and use [4]. These relationships normally exist in nested hierarchies.

III. Built Form and Its Significance as a Reference Aspect

In general, physical spaces and built form mediate social, economic and environmental sustainability [48]. There is reason to believe that the built form itself plays a role in fostering the conditions that support societal goals [49], [50]. The findings support claims that aesthetic and historic cultural importance may influence community feelings or increase neighbourhood social use [49]. "As cities develop and transform, its evolution is reflected through the built form" [9, *153*].

F. Significance as a Reference Aspect

Figure 4 shows the number of articles representing combinations of the urban form aspects. From these combinations, one can deduce that the built form is a reference aspect that coordinates the other aspects. As a reference aspect, the built form is significant because it has four important attributes: it is universal, enduring, tangible and accommodating [4], [13]. These characteristics distinguish the built form and show its coordinating role.

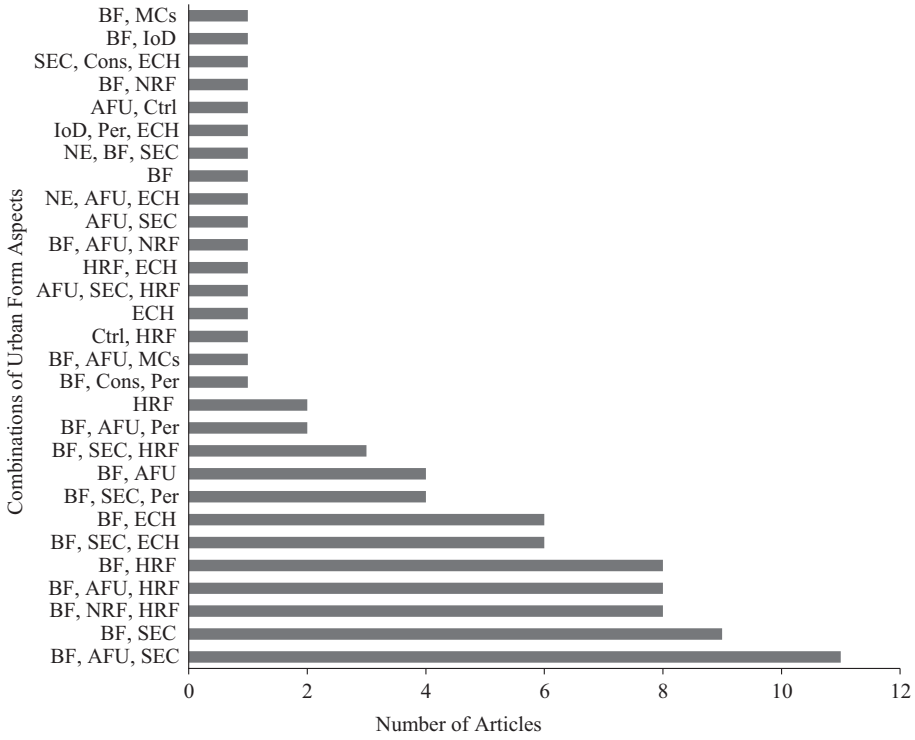

Fig. 4. Number of articles representing combinations of urban form aspects [developed by authors]. Note: NE = natural environment or site; BF = built form; AFU = activity, function, or use; SEC = sociocultural and economic context, or local culture; Ctrl = control; IoD = intention or design; Cons = construction; Per = perception; NRF = natural resource flows; HRF = human-directed resource flows; ECH = evolution, changes, and historical development; MCs = morphological characters [developed by authors].

1. Universality: This connotes that the built form constitutes global elements with similar characteristics irrespective of context. Some attributes that make the built form universal are growth [51] and plan-element complexes: streets, lots and buildings [13]. Built form can foster an understanding of urban form elements, technology, urban design, architecture, aesthetics, etc. [9]. This important attribute makes it easy to graphically represent built form as drawings [4], [13], so that the graphic elements and drawings can be read and understood globally.

2. Endurance: Built form is seen as the most enduring aspect because it takes a longer time to transform, which means that it is slow to respond to changes in comparison to other aspects. Kropf [4], [13] considered this attribute as persistence. The fact that most settlement representations largely reflect physical form is a point connected to the form's general persistence relative to other elements [13]. Hence, the built form's enduring nature can be remarkable [52] as most historic features can be retained as tangible heritage.

3. Tangibility: The built form is considered tangible [8], as it can be seen and touched. Just like its universality, its tangible attributes provide the impetus for representing it graphically as drawings [13]. The built form provides a means of examining a city's physical elements as artefacts [53]. Although the built form's tangibility is significant, processes that are not tangible but happened in the past are important too [54].

4. Accommodation: Accommodation in this sense is significant, being tied to activity, function, or use [4], [13]. It means containing the other urban form aspects. Therefore, most studies relate the built form to one or more other aspects. For example, the relationships between built form and activity, function, or use have been emphasized [55], [56], [57], [58], where built form provides accommodation. In some cases, urban tissues are mostly residential land use, but they also house non-residential land-use elements such as schools, commercial centres and utilities [59].

G. Components: Plan-Element Complexes

Having considered its significance as a reference aspect, built form key components (the street system, lot system, and buildings and their related open spaces) require elaboration [58]. These key elements are not considered separate for urban morphological analysis; rather, they are tied together as plan unit or urban tissue. Being complex and hierarchical, the plan unit is the primary subject of urban morphological emergence, evolution and transformation [4], [18], [60], [61], [62], and object of

morphological analysis [53], [62]. Therefore, it is vital to account for how these elements relate to fully understand their attributes [63].

1. Street System: Streets and street blocks make up the street system and play an important role in making sense of a city's urban form. Their arrangement describes an urban tissue at the most general level [64]. The street system provides an avenue for travelling and recognizing a city; streets outline the diverse street blocks that form a city and differentiate the public from semi-public or private spaces [15]. As receptive components in the built form and because they provide the first contact with the city image, streets give people the first impression of a city [65]. Functionally, street accessibility [66], [67] plays a vital role in accommodating activities through occupation and movement [4], [13], [67]. Also, in terms of the built form attributes, streets are the most universal and enduring because it is difficult to alter their network compared to lots and buildings. The data availability to study street networks [53] and street connectivity [66], [67] has improved drastically due to advancement in computing.

In his study, Esfanjary [68] identified three street patterns in Maibud, Iran as "twisting alley, orthogonal pattern, and geometric system." Each street pattern has a connection to the historical phase of urban growth [68]. The study demonstrated how street patterns are connected to the urban form's emergence and evolution. In another study on Mexican street markets, five street market typologies were identified: linear, circuit, cluster, contour and hybrid [69]. The study tends to demonstrate the functions streets can attain. Moreover, the studies exemplify how the streets and street blocks can be seen and their forms used to accommodate public functions. In the contemporary urban state, there are pedestrian networks that are not defined as streets or sidewalks; these are the urban filaments that interweave into the prevailing flow configurations in historical and modern urban forms [70]. Filaments play an important role in the built form, as do streets and street blocks. Therefore, it is essential to examine these in the study of urban form.

2. Lot System: This is referred to as the lot series arrangement in a street block [18]. Lots can be seen in two ways: as a built form element and as a property by control means [71]. As a built form element, a lot is man-made, while as a property, it is claimed [71], [72]. Taking this relationship into account in defining the lot will aid in the understanding of urban form configuration, emergence and evolution [71]. The lot system has a relationship with cadastral composition, which, in turn, exerts an appreciable influence on urban form [73]. Lots have constantly presented useful evidence in interpreting urban changes; in a market economy, they are valuable land elements concerning investment and play a significant role in urban growth [74].

3. Buildings and Related Open Spaces: Although the Conzenian school divided urban landscape into town plans, building fabrics and land utilization [18], buildings are considered as town-plan unit in this discussion. In this sense, the buildings are viewed as individual units related to the respective lots they occupy and the street(s) through which they can be accessed. Though not only for the reason that buildings belong to town-plan complexes, substantial consideration has been given to the different buildings and urban spaces architecture, "also because building style is perhaps the most visible manifestation of the urban landscape" [74, *122*].

Open spaces and gardens represent the social influence nucleus over domains where value is put on the people's interaction essence to encourage vitality in neighbourhoods [25]. Fundamentally, any urban scheme aims at shaping public space where buildings shape this void and give it character [76]. Open spaces and gardens can serve different functions within the urban form. Although rarely accounted for in urban morphology, burial grounds also function as open spaces [52]. Other functions are recreation [77], parks and green space [78], and public squares and fountains [79].

IV. Urban Morphological Characters: Their Emergence and Evolution in Built Form

This section identifies what urban morphological characters are and how they are defined. It further explains the reasons and the ways they emerge and evolve, and finally, identifies their major types. Firstly, urban morphological characters are attributes that lend a distinct appearance to an urban tissue [19], [80], [81], [82]. Formation and transformation, patterns, hierarchies, and types [4] define these attributes. Urban morphological characters do not emerge and evolve by accident; they pass through formative and transformative processes. These processes give rise to patterns that tend to occur in hierarchies. These relationships produce different built forms and urban morphological characters. Considering the urban tissue, formative and transformative processes depend on human interaction with both the natural environment and built form. Also, the relationships among the streets, lots and buildings occur in nested hierarchies [19]. Within an urban tissue, "there is a pattern of patterns that extends into a hierarchy of interrelated forms" [4, *14*]. Process, pattern, hierarchy, and type are concepts significant to understanding why and how urban morphological characters emerge and evolve.

Secondly, urban morphological characters emerge and evolve to reflect the people's sociocultural and economic identity and their innovative expression and technological advances over time [19]. This emergence and evolution occur due to sociocultural and economic activities within the local context [4], [13], which drive urbanization processes [83] and vice versa. For example, Zumelzu and Barrientos-Trinanes [84] investigated urban form effects on neighbourhood vitality in Valdivia's (a city in Chile) five neighbourhoods. They found that some neighbourhoods have a higher degree of "morphological adaptability" in creating functional diversity. They further emphasized that land-use mix, block size, lot size and adaptability are four attributes that relate to improved human interaction in neighbourhoods. In this sense, their study indicated that urban morphological characters encompass spatiotemporal urban tissue attributes. The formative and transformative processes that combine town plan, building fabric and land utilization [19] result in urban tissue, a key component of transformation and urban growth [4].

Finally, two broad morphological character types corresponding to the organic and planned built forms are identified [85]. Also, sprawling and compact urban forms exhibit the two broad morphological character types. These dichotomies predominate in debates on urban form. However, there are diverse urban morphological character sub-types. For example, having mentioned significant inconsistencies in terminological usage in defining the core urban form elements, Fleischmann, Romice, and Porta [80] proposed a framework for classifying urban morphological characters. In doing this, they presented the "Index of Elements" that permits an unambiguous and non-interpretive urban morphological character description [80]. The index basically defines every urban morphological character matching the measure it calculates called the "Index" and the urban form element it measures called the "Element" [79, *6*]. Based on this, dimension, shape, spatial distribution, intensity, connectivity, and diversity are six categories under which 361 urban morphological characters were identified. This approach is one way they [80] identified urban morphological characters for quantitative analysis. The study provided a comprehensive character list of important urban morphology. Therefore, knowing these characters will aid in the understanding of urban morphological regions.

V. Summary and Discussion: The Role of Urban Morphological Characters in Town-Plan Regionalization

The urban form offers an avenue to analyse a settlement, especially a city. Figure 5 shows the role of urban morphological characters in town-plan regionalization. This represents the summary and discussion on this study. Studies on urban form fall into three broad categories based on relationships among spatial, spatio-temporal, and temporal elements. Firstly, in a spatial sense, the natural environment or site and the built form represent the physical urban form aspects. These are the most tangible compared to other aspects. Secondly, in a spatio-temporal sense, activity, function or use, sociocultural and economic context or local culture, control, design and intention, construction, and perception represent the six aspects dealing with human-environment relations. They are a mix of tangible and intangible elements. Finally, natural resource flows, human-induced resource flows, and evolution, changes and historical development represent the three aspects that are temporal and mostly intangible. This categorization tends to simplify the understanding of urban form comprehensively.

Among these aspects, built form plays the coordinating function. Within the built form, physical and non-physical elements or features interact [53] to produce urban tissue with specific morphological characters. The street system, lot system, and buildings and their related open spaces are all combined in a hierarchical structure to form urban tissue. The street system contains the streets in street blocks, which in turn accommodate the lots in lot series, and then the buildings in block form. This arrangement (a town plan) is part of the urban landscape and nested within it are the building fabric and land and building utilization [82]. These form a complex relationship and tend to exhibit unique attributes in a local context, giving the urban form some morphological characters.

Urban morphological characters emerge and evolve as attributes that give urban tissues uniqueness, thereby presenting different types. Formative and transformative processes, patterns, hierarchies, and types define these attributes. Also, the urban morphological characters' emergence and evolution reflect the local context's sociocultural and economic nature. Furthermore, such a local context reflects innovation and technology. How to precisely describe morphological characters in studying urban tissue is the most difficult endeavour [86]. Since the organic versus planned and sprawl versus compact dichotomies predominate in debates on built form, the role of urban morphological characters in town-plan regionalization is significant for urban landscape management.

As town-plan regionalization connotes the process whereby town-plan regions are identified and mapped [82], the role of urban morphological characters in this process can be seen in three ways: physical characterization, historical stratification and urban landscape management. Firstly, characterizing urban morphological regions physically involves tangible attributes defining urban tissues. For example, considering building footprints and building heights, urban morphological attributes can be calculated; these can include building volume density,

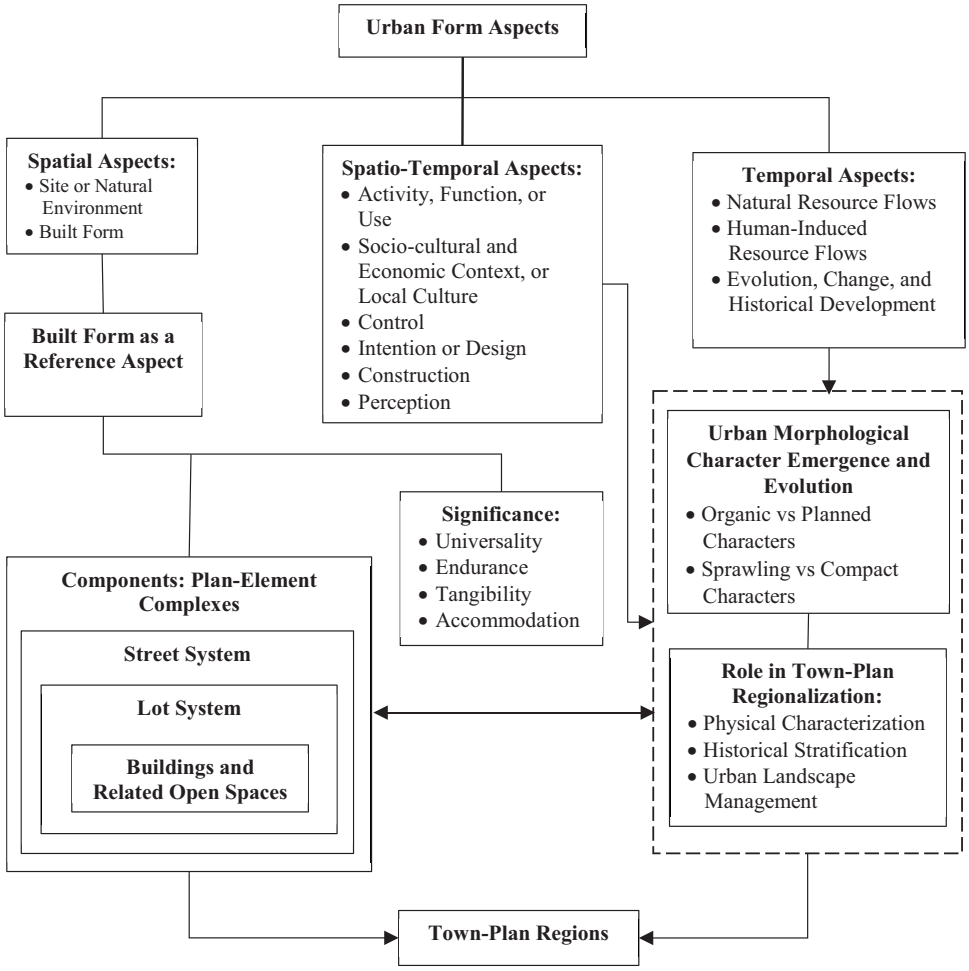

Fig. 5. The role of urban morphological characters in town-plan regionalization [developed by authors].

building coverage ratio, frontal area density and sky view factor [87]. These attributes are a few examples that represent the tangible urban morphological characters that are considered in town-plan regionalization. Therefore, a comprehensive methodological advancement to recognize and isolate the several urban morphological character elements is vital [81] for town-plan regionalization.

Secondly, historical stratification plays a vital role in town-plan regionalization. This is essential because urban landscape management requires inheriting the past urban morphological characters to develop town-plan regions. As the urban landscape is stratified historically, it requires a "genetic perspective" [19]. The urban landscape contains distinct periods, town plans, building fabrics, and land and building utilization with various town-plan regions [19], [58]. These distinct blends exhibit various urban morphological characters. Therefore, it is important to analyse urban morphological characters in terms of the urban landscape's historical development. Recognizing this historical stratification "provides an important basis for an integrated framework for planning, urban design, and urban landscape management" [87, *148*].

Finally, urban landscape management is significant because it ensures conservation planning, successful place creation and urban design control [82], [88]. In conservation planning, the urban landscape's value and perception is a huge attraction source. This seems to rely on urban morphological characters. Also, the success of place creation or modification requires urban morphological character analysis. This process ensures proper town-plan regionalization knowledge for urban landscape management, which is essential for urban design control. In urban form research, the focus has shifted to town-plan regionalization for urban landscape management, which is essential in conservation planning, place-making and urban design control [82], [89]. However, the role of urban morphological characters in town-plan regionalization has received little attention in recent years.

VI. Conclusions and Future Research Agenda

Amidst urban form's growing research, morphological character knowledge is essential to town-plan

regionalization. There is considerable urban morphological character research. However, the existing knowledge of their role in town-plan regionalization is limited. This paper reviewed urban form aspects, built form as a reference aspect, and urban morphological characters, and finally discussed their role in town-plan regionalization. Although urban form has been misconstrued to mean only physical landscape, its aspects are identified to encompass spatial, spatio-temporal, and temporal elements. These elements are analysed within the built form as a reference aspect, and their combination produces urban tissue containing urban morphological characters that play a significant role in town-plan regionalization. Emphasis has shifted to town-plan regionalization in urban form research towards landscape management because of its importance to conservation planning, place creation and urban design regulations.

However, comprehensive research is necessary to expand the link between urban morphological characters and town-plan regions through the lens of evolution, changes, and historical development with a focus on sustainable development. While urban morphological characters and town-plan regions belong to sustainable development's environmental dimension, social and economic dimensions drive it. It is important to understand how environmental, social, and economic factors shape urban morphological characters and town-plan regions towards heritage and conservation planning. Furthermore, this will aid in developing a framework for urban landscape management, which is important for modifying existing and creating new urban tissues with the goal of enhancing future morphological characters and town-plan regions. In addition, perception as an urban form aspect can be seen as belonging to the social dimension. When the relationship between urban morphological characters and perception is studied, the outcome can be used to improve a city's image. Regarding these needs, it is important to examine the built form and map its morphological characters and town-plan regions in certain sociocultural and economic contexts in developing countries. Doing this will conserve the historic urban characters and their embedded local values and wisdom, which may tend to attract and support people, thereby boosting such countries' livability and tourism potential.

Acknowledgements

This research was supported by the Research University Grant Scheme of Universiti Teknologi Malaysia under UTM Fundamental Research Q.J130000.2552.21H73 and Industry-International Incentive Grant Q.J130000.3652.03M43.

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