Aspects of urban form

Karl Kropf
Urban Morphology Research Group, University of Birmingham and
Roger Evans Associates Ltd, 59-63 High Street, Kidlington, OX5 2DN, UK.
E-mail: kkropf@rogerevans.com

Revised version received 23 March 2009

Abstract. *The diversity and complexity of human settlements is reflected in the range of ways we try to understand them. The richness of subject matter presented by cities has given rise to an equal richness in methods of investigation. Even within a single field such as urban morphology, there are different approaches with different terms of reference. The challenge raised by the diversity is not how to select between the different views but how to combine and co-ordinate them. The purpose of this paper is to undertake an initial critical analysis of different approaches to urban morphology in an effort to meet that challenge. The first aim is to identify the range of different phenomena taken as the object of urban morphological enquiry. The second is to identify an aspect that is common to all the approaches and that can be used as a reference key to co-ordinate different views in a rigorous way. The ultimate goal is a composite view in which the different approaches support each other to provide a better understanding of human settlements.*

Key Words: urban form, spatial analysis, space syntax, process typology, historico-geographical approach

It might be said that the gamut of human civilization is condensed within the urban. Villages, towns and cities present a density and richness of subjects that is hard to find in any other human product. That richness is evident not only in the wide diversity of settlements and the depth of their complexity but also in terms of our capacity to identify and select different aspects to explain.

Just as settlements are diverse and complex, so there are many ways to describe and understand them. To only touch the surface, approaches range across the broad categories of social, economic and environmental and focus variously on the statistical, spatial/ geographical, formal, historical, psychological, informational and aesthetic dimensions. Even within a particular area of interest, there are commonly a number of different approaches focusing on the same thing.

So, if we acknowledge that human settlements are diverse and multi-faceted, we should not be seduced by the superficial attractions of a single point of view. And to acknowledge the wide range of methods should not put us on a tower of Babel, deaf to the voices of others. Rather it should place us at the confluence of routes radiating out to the different regions of the world. This is particularly true of the morphological approach which, as originally conceived by Goethe, should be an independent study that makes use of the findings of all the other sciences, co-ordinating them under the unifying aspect of form (Wilkinson, 1962, pp. 177-8).

 © International Seminar on Urban Form, 2009 ISSN 1027-4278

A similar, though slightly stronger, view comes from Kevin Lynch (1981, p. 37) who likens theories of city form to the branches of a tree, but states that,

> unlike the branches of trees we know, they should not diverge. They should interconnect and support each other at many points. A comprehensive theory of cities would be a mat of vegetation, and some day the branches will no longer exist in separate form.

Even in seeking the milder connections of co-ordination (as opposed to a comprehensive unification), the current state of our understanding would appear to acknowledge there are a number of unresolved splits or gaps to bridge along the way.

There is the disparity between the fact that cities are the result of deliberate and co-ordinated human effort on the one hand and exhibit characteristics of 'self-organization' and emergent behaviour on the other. Can cities be both planned and emergent? If they are both, what is the balance between the two and can we articulate the relationship and interaction in more detail? What is the relation between local processes and global structure?

There would also appear to be a parallel split between on the one hand our ability to identify and describe coherent structures and relationships and on the other the seemingly inescapable level of ambiguity that emerges from close scrutiny. By what means should we seek to co-ordinate the different views and approaches?

In a number of fields, evolutionary thinking seems to be providing a common framework with the most promising potential to bridge these gaps. Yet again, it is not clear that there is a common idea of what exactly is evolving or adapting. Nor is it clear which (or which combination) of the related theories of evolution, developmental biology (morphogenesis) or ecology is most appropriate to apply (Kropf, 2001; Steadman, 2008). This should perhaps not be surprising because in a profound way we are approaching the matter backwards.

Theories of evolution developed out of lengthy, progressive efforts of classification and the perception of relationships between the species classified. Those theories have been elaborated and refined over a similarly long period of time so that we now have the benefit of ready-made theories that we can try to apply to a range of phenomena. The elaboration of the theories has also fed back to ideas about classification, which have been refined in turn. In the case of human settlements, if we acknowledge the complexity, diversity and ambiguity of the objects we are seeking to understand and the range of different ways we currently use to describe them, it is fair to say we do not have the benefit of a clearly defined set of objects to explain.

The wider state of affairs reflected in these questions is represented as a kind of microcosm within the field of urban morphology. There are several distinct approaches to the study of human settlements that go under the banner of urban morphology. Close examination of key texts suggests that 'urban form' is described in a number of different ways in the different approaches. The gaps do not represent insuperable barriers. Already the different approaches are broadly complementary. How could they be made more rigorously and effectively so?

The purpose of this paper is to explore these issues through a critical analysis of a few core concepts used in the various approaches to urban morphology. The aim is to find a specific means of co-ordinating the findings of the different approaches and help them work together and realize the significant potential to establish a richer multiple description. With a richer and co-ordinated description it might then be clearer how the various elements fit into or inform evolutionary thinking.

Methodology

The goal of the analysis is to identify a common element, defined in a consistent way, that can be used as a reference key or registration mark to co-ordinate different descriptions. The analysis is not meant as a deconstruction but a sorting through and comparison of existing concepts and methods.

Because the analysis entails a comparison of texts, it necessarily entails a scrutiny of language and the concepts and phenomena to which the language refers. That in turn focuses attention on the particular characteristics of the phenomena that are pertinent to the authors' own objectives (Eco, 1979, pp. 77-8, 245-61; Putnam, 1995, pp. 5-26). The analysis therefore involves a sorting or classification of pertinent characteristics into general categories.

This focused analysis is part of a more general process of enquiry that seeks to describe and explain the phenomena in question. Broadly, it is a free movement or iterative cycling through hypothesis, deduction and induction (Peirce, 1958, p. 367). The standards for the deductive component of the enquiry are those of formal logic. Of particular importance is the distinction made between class, relation and property and between a class and a member of the class.

For effective comparison, it is necessary to establish a consistent method of analysis using the same set of terms for all examples. Because the common view used in analysis is to see each in terms of classes, relations and properties, this then provides the best basis for comparing terms. The question to be asked is, are the terms used in each method defined in the same way? If not, which offers a better definition? The second question demands a value judgement. The primary criterion for evaluation is *consistency*: all instances of a given definition should be based on the same pertinent characteristics. Secondary criteria include *specificity* – definitions should clearly posit classes of identifiable phenomena in sufficient detail; *generality* – definitions should be based on pertinent characteristics found in as wide a variety of examples as possible while still allowing for the identification of specific differences; *comprehension* – definitions should account for as wide a range of objects as is appropriate to the task of explanation; *coherence* – definitions should be related to each other in a consistent way in order to form a clear structure.

Urban morphology

The obvious and perhaps superficially belaboured starting point for critical analysis must be the terms *urban morphology* and *urban form*. It is the multitude of assumptions packed into those terms that is of particular interest, not at a wider semantic level but in terms of the operative definitions manifest in the works within the field.

While *urban* by derivation and connotation refers specifically to cities, the work of urban morphologists clearly suggests that the term is taken to refer more broadly to human settlements. Examples include the studies by Conzen (1966) of small market towns and linear settlements, the works of Slater (1982) on market towns and rural settlements, studies of suburban development and fringe belts (Stanilov and Scheer, 2004; Whitehand and Carr, 2001; Whitehand and Morton, 2003) and examination of modern peripheral development (Levy, 1999) to cite only a few.

Morphology, as originally conceived by Goethe (1952) (see also Wilkinson, 1962) is the study of physical form, principally of living things but also works of art. His major insight and contribution was to relate the outward form of an organism or artistic creation to its internal structure and to define the internal parts making up that structure in terms of their position relative to each other. Importantly, Goethe also saw outward and internal form as the product of a process of formation and transformation.

It is worth noting that comparative gross morphology in plants and animals is one form of evidence that led to theories of evolution. For example, similarity or, more strictly, homology of internal structure such as the skeletal structure of mammals, suggested a common descent.

While it may again seem laboured, to get at the use of *morphology* within the sphere of human settlements, it is worth examining the use of 'urban morphology' in non-specialist contexts. Concepts, ideas and theories are fundamentally social and reside, as it were, within a population (Eco, 1979, p. 66; Peirce,

1958, p. 69). Simplified, outdated or 'partially correct' concepts, if commonly held, can present an inertial weight or resistance to change (Dennett, 1995; Gould, 1991, 59-75).

School urban morphology: the persistence of Burgess and Hoyt

In a number of documents and websites intended for school level geography (for example, the General Certificate of Secondary Education in the UK), urban morphology is defined as 'the pattern of land use within a town' (an example in book form is Helm and Robinson, 2002). The models cited are the concentric zone (Burgess, 1925) and sector (Hoyt, 1939). The material makes reference to bid-rent theory, functional zones, central business districts and residential zones distinguished by income groups. Some sources also distinguish between cities within More Economically Developed Countries and Less Economically Developed Countries for purposes of comparison.

To go beyond the superficial interpretation of 'land use' in this instance, it should be remembered that Burgess was a sociologist and referred to his own work as an ecological approach. With this in mind it is fair to say that his ideas discerned the relationship between human activities and their urban environment.

In the *Dictionary of the social sciences* published by Oxford University Press (Calhoun, 2002), the focus on land use is shifted and qualified, perhaps as a reflection of a target audience further through the educational process. The definition states that urban morphology

> refers to the shape of a city, including its architecture, layout of streets, and different densities of habitation. It is often distinguished in urban studies from functional zonation – the pattern of land use in a city.

The examples present two different conceptions of urban form that each distinguish two more or less distinct aspects: physical form and land use or function.

The pragmatic insights of Kevin Lynch

Working within the fields of urban planning and urban design, Kevin Lynch (1981) highlights the lack of clarity in the consideration of *form* with respect to *use*. He explicitly defines settlement form as

> the spatial arrangement of persons doing things, the resulting spatial flows of persons, goods and information, and the physical features which modify space in some way significant to those actions, including enclosures, surfaces, channels, ambiences and objects. Further, the descriptions must include the cyclical and secular changes in those spatial distributions, the control of space, and the perception of it (p. 48).

In Appendix B (p. 349) of the same book, however, he warns that

> while standard descriptions agree on emphasizing human activity in its relation to physical form, they are prone to confound the two in a single ambiguous description, such as 'single-family house' or 'church'. Is it a type of building that is being denoted, or the activities of worshipping or residing?

If interpreted broadly, his initial definition of settlement form encompasses the whole subject of urban morphology. Yet his caveat also points to the potential hazards implicit in our modes of description. Lynch is clearly stating that the fluidity between form and use in common names and descriptions, even within specialist spheres, can be a barrier to understanding.

The potential for conflating different aspects is not limited to form and use. Lynch's definition of form contains within it a number of distinct features that should be made more explicit if descriptions, explanations and proposals are to be clear and coherent. Just as Lynch has distinguished between the class of 'physical form' and its relation to the class 'activities', it is possible to examine the remaining parts of his definition in terms of classes, relations and properties.

'Physical features which modify space in some way' clearly refers to the class of

physical objects and their spatial relations, which, in a number of cases result in a pattern of solid and void such as the interiors of buildings or patterns of streets and blocks. 'Enclosures', 'surfaces', 'channels' and 'ambiences' (in the sense of 'surroundings') are different types of object or space created by the spatial relation or arrangement of objects.

'Persons doing things' and 'flows of persons' refer to the class of humans and the property of being engaged in some activity, including movement, and imply the relationship with the object or space that accommodates the activity. 'The flow of goods and information' refers to classes of object and the property of movement sharing the relation of being directed by humans for human purposes.

The 'control of space' and the 'perception of space' are two different types of relation between a human (or group) and a space (and, by implication, part or all of the objects that define the space). A space or object is controlled *by* someone or some group and, equally, perceived *by* someone or some group. The concepts of control and perception make no sense without both sides of the relation.

'Cyclical and secular changes in spatial distribution' refers to alterations in a class or object over time. The two broad temporal relations are continuity and change. Both change and continuity can only be described with reference to at least two states of the same 'thing'. What becomes important in describing the relations is the evidence we have for previous states in order to describe the relation one way or the other.

Compressed within Lynch's concise definition of urban form are six distinct aspects:

- physical form
- use/activities/movement
- control
- perception
- continuity/change
- movement or flow of materials and information

Looking back at the definitions examined previously, the first only explicitly included use, qualified by the relative position of occupants within a social structure (social status). The second included both physical form and use. The six aspects picked out by Lynch, as already noted, cover most of those included within the discipline of urban morphology. For the purpose of determining more explicitly which aspects are included in the different approaches to urban morphology, four distinct approaches can be identified, each taking a slightly different view of form:

- spatial analytical
- configurational
- process typological
- historico-geographical

The spatial analytical approach

The spatial analytical approach is perhaps best characterized by the work of Michael Batty and the Centre for Advanced Spatial Analysis at University College London. Using a range of methods and models including GIS, cellular automata, agent based models and fractals, Batty seeks to understand the spatial structure and dynamics of cities as complex, emergent phenomena, in which global structure develops from local processes. Citing Jane Jacobs (1961, p. 349), Batty sees the city as a problem of organized complexity and applies the concepts of emergence and evolution in moving toward solving that problem.

The models employed and cited by Batty are openly stated to have a loose correlation with the *scale* of the phenomenon modelled (2007, pp. 35, 144-6). The models might represent city regions or areas within a city. Cells in a model 'most appropriately' represent plots or parcels or their simple aggregations but might fall somewhere between parcels and census tracts or other administrative aggregations depending on the source of the data.

Similarly, the specific objects modelled are openly left loose. In many cases they can be interpreted to represent generic development

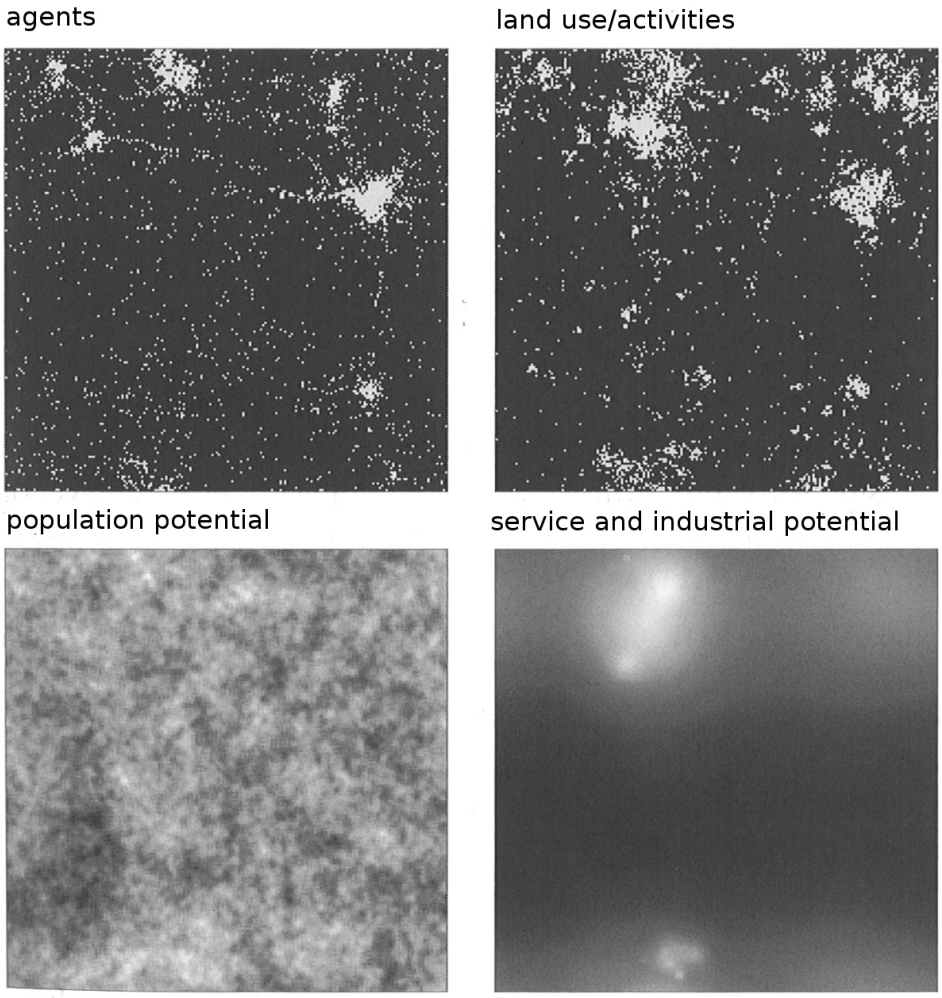

Figure 1. Graphic output from an agent-based computer model of a sub-regional urban system (reproduced from Batty, 2007, p. 253).

or 'built-up area' and in some cases the models include routes. The concept of the 'neighbourhood' is fundamental to the functioning of the cellular automaton as a model but it is defined explicitly in terms of the structure of the model rather than the phenomena modelled. Importantly, there is ambiguity surrounding 'form' and 'use' in what is represented. Much of the work cited by Batty deals with changes, growth and segregation of land uses as well as the diffusion or migration of resident populations based on a range of factors (2007, pp. 142-3, 154) yet the 'morphologies' that emerge from the models most clearly resemble the spatial distribution of urbanized areas within a sub-region (Figure 1). Indeed, Batty states that the models are not intended to provide accurate or predictive descriptions but to 'strip the processes of city growth to their bare essentials, and thus to uncover the basic mechanisms at work' (2007, p. 109).

There seems to be a deliberate blurring of the aspects of physical form and use at different spatial scales. Yet it would not seem to be outside the realms of possibility that, given an appropriate point of reference, the models might be calibrated to complement more accurately other forms of description.

The configurational approach

Space syntax represents the configurational approach to urban morphology, which seeks to

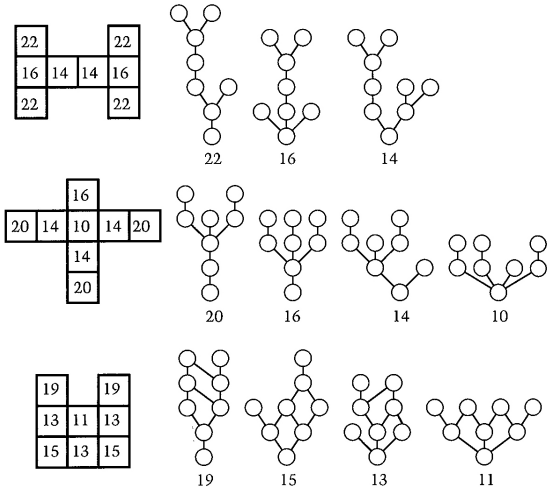

Figure 2. Examples of j-graphs, which illustrate the abstract connections and relative positions of a spatial configuration (reproduced from Hillier, 1996 p. 102).

understand the spatial structure of settlements through a range of analytical methods. At the scale of settlements, the theoretical basis of the approach is the relationship between spatial structure and the generic function of movement.

> The... fundamental correlate of the spatial configuration is movement. This is the case both in terms of the determination of spatial form, in that movement largely dictates the configuring of space in the city, and in terms of the effects of spatial form, in that movement is largely determined by spatial configuration (Hillier, 1996, p. 152).

Like Batty, Hillier sees configuration as emergent, with global structure arising out of local processes.

With respect to the notion of form, space syntax takes a distinct view because of its emphasis on space and spatial configuration, rooted in the analysis of buildings (Hillier and Hanson, 1984). The concepts and analytical methods focus almost entirely on the voids of a structure, principally the street spaces within a settlement, though some consideration is given to the spaces around buildings within a plot.

For Hillier, 'spatial form' is the arrangement of spaces, with explicit reference to the position of any given space within the structure of the configuration as a whole. This formulation necessarily implies or assumes the 'solid' that defines the space or void. The different analytical techniques employed within the space syntax represent the structure of solid and void in different ways. In the more abstract techniques such as j-graphs, the solid is not explicitly represented at all (Figure 2). To make sense of the analysis, however, the solid must still be assumed to define the void. In the case of axial and convex space mapping, the solids are explicitly drawn, or are at least used to generate the axial and convex maps, and correspond to street-blocks (Figure 3). It is important to note that axial and convex space mapping are intended to represent what can be seen by a human within a space. The approach therefore implicitly includes the relation between humans and physical form. In terms of the aspects set out above, space syntax includes:

- space / physical form
- use/occupation/movement
- perception

The process typological approach

The process typological approach to urban morphology is rooted principally in the work of the Italian architect Saverio Muratori but is best represented by the work of the architect and urbanist Gianfranco Caniggia, who studied under Muratori. The approach they developed seeks to inform their architectural and urban proposals with an understanding of the built environment by examining its detailed structure and the historical process of its formation. They begin with the general distinction between spatial and temporal relations, which they refer to, respectively, as *copresence* and *derivation* (Caniggia and Maffei, 2001, pp. 62-5). The analysis of copresence proceeds from an abstract set or schema of component subdivisions that forms a hierarchy: elements, structures of elements, systems of structures, and organisms of systems. This schema is first applied to indi-

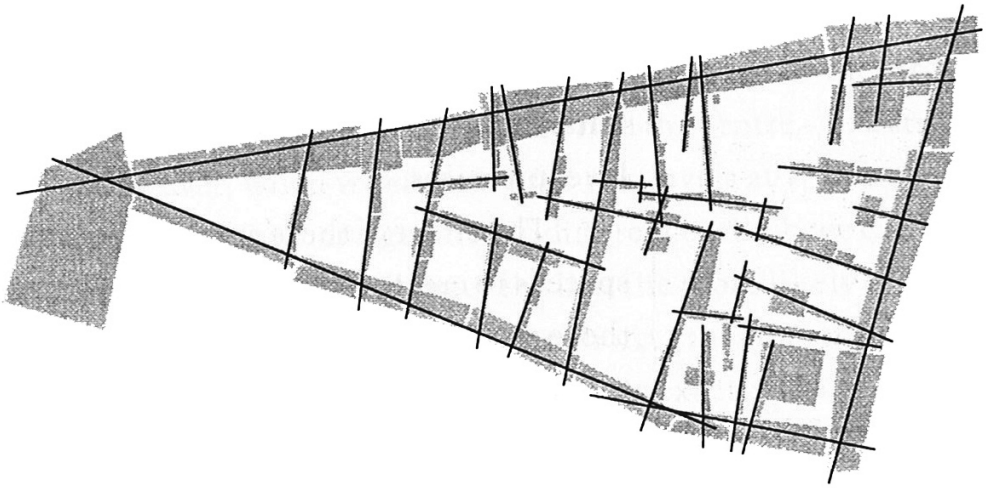

Figure 3. Superimposed mapping of convex spaces and axial lines for part of central London (reproduced from Hillier, 1996, p. 157).

vidual buildings, with building materials such as bricks, timbers, tiles etc. taken as the elements. The structures of elements are then the associations of building materials within such things as walls, interior floors, roofs etc. Systems of structures are arrangements of the latter into rooms, stairs, corridors etc., the organism being the building. The same scheme is applied to towns, taking buildings as elements. The structure of elements is an association of buildings or an urban tissue, in general referred to as an aggregate (Figure 4). The system of structures is then a combination of tissues forming regions or districts, which taken together form the organism of the town (Caniggia and Maffei, 2001, pp. 73-4).

The forms found at the different levels are identified as *types* which are conceived as cultural entities rooted in, and specific to, the local process of cultural development. The operation of the process over time and in different places leads to development and change and diversification of forms. Function is therefore implicit in the type concept in that any form will have been initially conceived and developed to satisfy a particular human need or desire. Throughout their texts, Caniggia and Maffei refer to the functions of the different types of forms at the different levels in the hierarchy. While different local processes lead to distinct forms, there is a generic similarity to the process which is characterized as derivation. At the time of construction, the form of a building is based on an idea or concept derived from the shared experience of previous buildings or modifications of them. The *idea* of the building and the act of construction or modification are thus essential parts of the cultural process and are distinct in terms of classes, relations and properties. The idea involves the relation between the shared cultural concept and the population that holds it and the act of construction involves the relation between the builders and what is built. Caniggia and Maffei thus identify the following distinct aspects of urban form:

- physical form
- function/use
- the idea of the building or form
- the act of construction/modification
- the cultural process of derivation and/or development/change

The historico-geographical approach

The historico-geographical approach to urban morphology is rooted in and well summarized by the work of the geographer M. R. G. Conzen. The aim of Conzen's town-plan

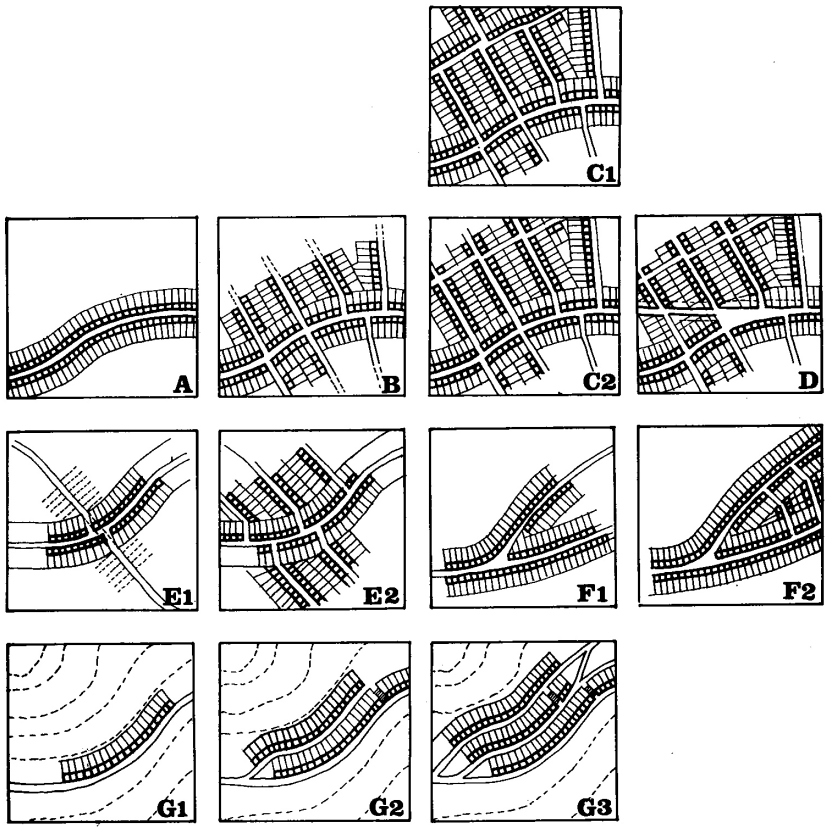

Figure 4. The formation of urban tissue or aggregates in different generalized situations (reproduced from Caniggia and Maffei, 2001, p 130).

analysis is to explain the geographical structure and character of towns through a systematic analysis of their constituent elements and development through time. As set out in his seminal study of Alnwick (1969, pp. 3-5), he begins by distinguishing five general aspects:

- site
- function
- townscape
- social and economic context
- development

Within the townscape, he distinguishes three form complexes:

- town plan
- land utilization pattern
- building fabric

The town plan is itself subdivided into three complexes of plan-elements:

- street system
- plot pattern
- building pattern

The constituent element of the street-system is the street; the element of the plot pattern is the plot and the element of the building pattern is the block-plan of the building. Further, distinct combinations of streets, plots, and block-plans are identified as plan-units (Figure 5).

Looking at the five general aspects in terms of classes, relations and properties, function and social and economic context are both based on the relations of 'use' or 'activities' between humans and built form. Function is more limited and specific to particular classes

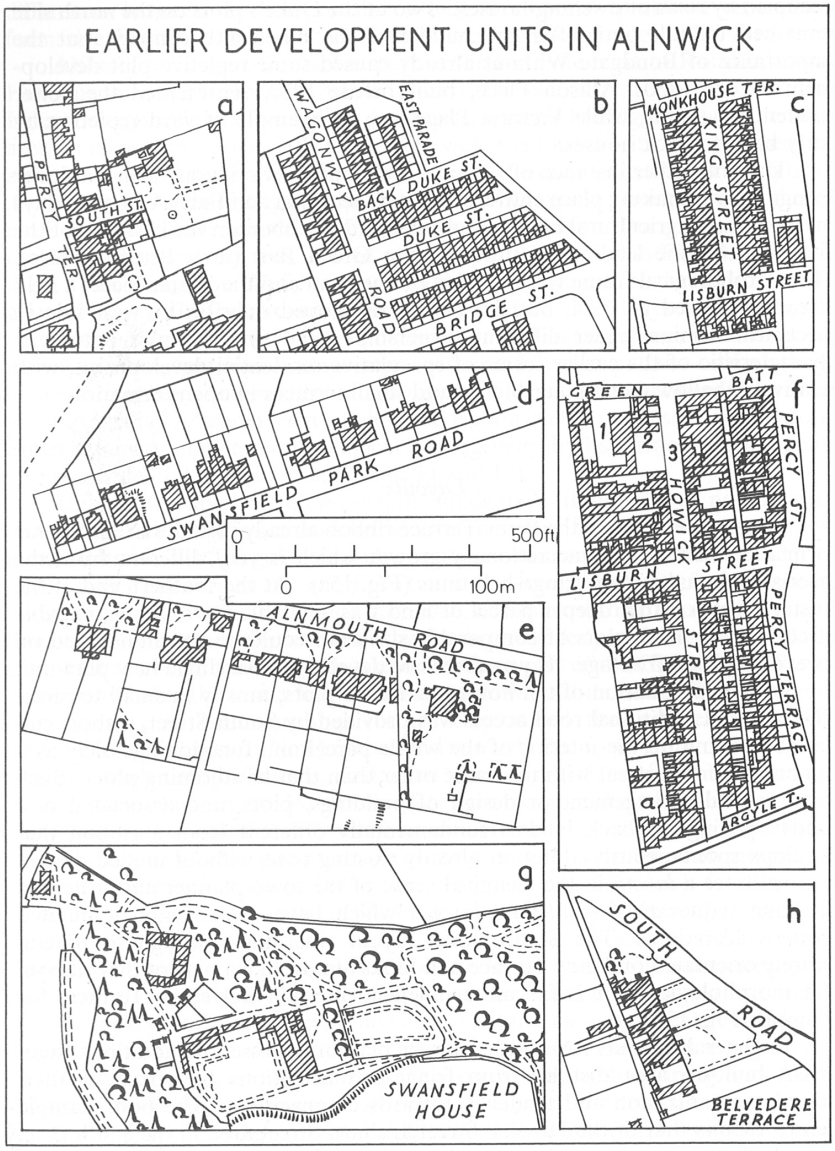

Figure 5. Examples of plan units: Alnwick, Northumberland (reproduced from Conzen, 1969, p. 72).

of activities, for example residential or commercial. The social and economic context is the combination and interaction of different activities and functions over a wider area. In this respect any given 'function' is a part of the social and economic context. Site is defined principally in terms of the spatial relations and distribution of natural physical features such as geology, topography, hydrology and vegetation. As with Lynch's change, the process of development involves the temporal relations between elements and aspects from one time to the next.

Examination of the townscape as defined by Conzen raises a number of ambiguities concerning the element of the plot. Despite function having been identified as a distinct general aspect, the townscape includes the form complex of land utilization pattern with the plot identified as a unit of land use (Conzen, 1969, pp. 5, 79, 128). The town plan also includes the element complex of the plot pattern. The plot is thus defined in terms of both land use and physical form. This raises

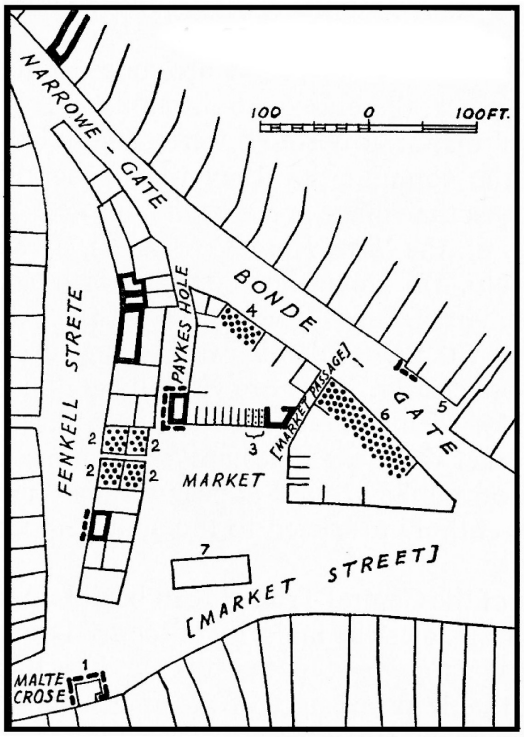

Figure 6. The pattern of pre-industrial property holdings in Alnwick, Northumberland (based upon Conzen, 1969, p. 35).

the issue flagged up by Lynch of conflating form and use and therefore blurring or obscuring the dynamic associations between the two. Conzen himself openly recognizes the importance of these links, noting that

> town plan and to a lesser extent building fabric are conservative in that they tend to reflect the pattern of past landownership and capital investment longer ... The land-use pattern responds more easily to changing functional impulses (Conzen, 1981, p. 80).

To be more consistent, the categories of 'social and economic context', 'function' and 'land utilization pattern', which are all defined by the human-built form relation, would be better included together as a separate aspect.

Conzen's mention of land ownership in the above quotation and illustration of property holdings in his study of Alnwick (Figure 6) raises a further point of ambiguity associated with the plot. In common use, the plot refers to a unit of property. As with form and use, there is the tendency to conflate the physical form of plots and their status as an object of ownership or, more generally, control. While the physical boundaries of plots generally correspond to the boundaries of control, it is not always the case (Kropf, 1997). More fundamentally, the concept of ownership and other forms of control involves a socially defined relationship between the controller and the thing controlled. One does not make sense without the other. Just as with use, however, control is a fundamental aspect of urban form and is an essential factor in understanding the process of development. The issue of control is the subject of an entire chapter in Lynch's *Good city form* and is central to a number of other works within the typological approach, in particular Habraken (1998), as well as Moudon (1986) and Castex *et al.* (1980, 2005).

In accord with the foregoing analysis, Conzen's method identifies four principal aspects of urban form:

- site
- social and economic context, function, land utilization
- townscape
- development

The further aspect of control is implied by Conzen in the identification of the plot as an element. This is reinforced by the explicit inclusion of control as an aspect by others within related approaches.

The case for physical form as the reference aspect

The results of the analysis are presented in Table 1, which groups the different aspects by general class and relationship, the four broad groups being spatial relation of physical objects, interrelations between humans and

Table 1. General aspects of urban form as identified in the various approaches to urban morphology

Spatial relations of physical features	
Site/environment	Spatial relations of natural features unaltered by humans (the substrate of built form).
Built form	Spatial relations of features built or modified by humans, encompassing both solid and void and including planted vegetation.
Interrelations between humans and physical features	
Social and economic context/local culture	Collective relations between human activities and between human activities and physical forms.
Function/use/activity	Relations between humans and physical forms for particular purposes including movement and occupation.
Control (e.g. ownership)	Socially acknowledged relations between an individual or group and a physical form conferring powers of action and determination over the form.
Intention/design	The sense or mental image motivating the modification or construction of built form including representations such as drawings.
Construction	The act of modifying or constructing built form.
Perception	Mental and physiological response or experience of being in a place and the image or sense retained in memory.
Flows of resources	
Natural	Sunlight, wind, water etc.
Human	The movement of goods, information, energy, waste.
Temporal relations	
Change/development	Short-term cyclical changes in patterns of activity and long term transformation of the natural and built environments necessarily described in terms of states at two or more points in time.

physical form, flows of resources and temporal relations. The different aspects are then distinguished by the specific classes and relationships. The aspect of resource flows, which is included by Lynch as a distinct part of built form, is noted and very usefully elaborated by Osmond (2008), as is the importance of vegetation.

The aim here is not, however, to set out a comprehensive set of aspects. It is to identify which amongst the commonly identified aspects provides the best reference key or registration mark for co-ordinating the other aspects so that different descriptions can be correlated in a rigorous way. Whichever aspect is chosen, if it is to function as the reference key, it should be common to all the approaches and defined consistently as distinct from other aspects in order to avoid the problems of conflation.

Of all the aspects identified, physical form and use are common to all the different

approaches. There is, however, an important distinction between these two aspects that is an essential consideration for choosing a reference aspect that can be defined in a way that is consistent, coherent and comprehensive. If defined strictly, physical form is the spatial relations of physical objects. Function, use and activity are interrelations between humans and some physical form. When we refer to use, we talk about the use *of* some object or space defined by objects within a town. Functions such as residential or employment presuppose the infrastructure, building and equipment that accommodate the activities. It is this fact that leads to the tendency noted by Lynch to conflate the two.

There is no question that activities and uses can be defined without reference to physical form. But the very fact that activities such as residing, worshiping, working and playing are, on their own, relatively fluid and flexible, both in their constituent elements and where they take place, means they are less suited as a reference aspect. Use is more evanescent and changes more quickly than form, as was long ago noted by Conzen. Physical form is the most tangible and persistent of all the aspects.

A point related to the general persistence of form relative to other aspects is the fact that most representations of settlements primarily depict physical form. As the most tangible and ubiquitous aspect, it is the easiest to represent by drawing and other graphic means. In cases where other aspects are represented, such as property boundaries on cadastral maps, the ultimate reference point is still physical features on the ground (Kropf, 1997). If we are to reconstruct the process of development of settlements, the source material with which to do so is most likely to be representations of physical form.

The tangibility, ubiquity and persistence of physical form make it the most suited to act as the point of reference for co-ordinating and comparing aspects. This seems at once both obvious and too simple to mention. But the cost of neglecting such a fundamental matter is a field of enquiry that is surprisingly incoherent and unco-ordinated. Consolidating the insights of different groups to build a more effective body of knowledge and understanding is extremely difficult.

Pertinent features of physical form

Focusing on physical form as a reference aspect out of a range of co-dependent aspects of urban form is not as simple as it might appear. If it is obvious that physical form should be the point of reference, it is equally obvious that the physical form of human settlements itself presents a diversity of aspects. The different approaches to the study of form tend to abstract different features of physical form as pertinent to their investigations and represent them in different ways. At a general level, features and relations include the following:

Features
- line
- area/patch
- space
- module (solid/void)

Relations between features
- network
- patchwork
- aggregate cluster
- cellular matrix
- fractal
- hierarchy
- palimpsest

To an extent, the different approaches can be characterized by the features they take as pertinent and the relations between them:

- spatial analytical (patch, aggregate cluster, matrix, fractal)
- configurational (line, space, network)
- process typologogical (module, modular hierarchy)
- historico-geographical (area or patch, patch hierarchy, palimpsest)

Just as all of the different aspects of urban form are co-dependent facets of the same phenomenon, the different features and

structures are different views of the same aspect. As such, there must be points of contact when different views are overlaid. Finding those points of contact is the challenge to be met in seeking to co-ordinate the different views so that they might work together and reinforce each other.

To put the issue in these terms is in some ways to overstate the case. Identifying common features to use as the registration mark should not be a major intellectual feat. The analogy with multi-plate printing implied by the term 'registration mark' can be used as a pragmatic methodological pointer. If the different aspects of urban form and the different features of physical form are seen as different colours, each with its own pattern applied to a separate plate, it is the registration marks applied to each plate that make it possible to co-ordinate the printing of all the plates and generate a coherent image.

The analogy is plausible in the first place because virtually all of the approaches to urban morphology make use of two-dimensional graphic representations of urban form, typically using the conventions of orthographic projection in plan. For the analogy with printing to work, the first obvious practical point to acknowledge is that all the different aspects need to be shown from the same point of view at the same scale. As in printing, the registration marks might then even be independent of the image and work like a grid reference in mapping. The benefit of a reference aspect that is part of the image is that it is always there to be used whatever the view.

Conclusion

It may seem perverse to pick apart urban form only to try to put the pieces back together. To a large extent, however, this is the essence of morphology. The purpose of the analysis and synthesis is not to compile an exhaustive table of deracinated parts. To go beyond a mindless disassembly, there is an absolutely essential third component to the process which is *comparison*. To a large extent comparison is at the core of perception and operates at a subconscious level. Goethe's brilliance was to bring that intuitive capacity into conscious application. He compared one form with another. He compared the different component parts and their relationships and he compared the different stages in the development, growth and transformation of forms. He also overlaid and compared the information about the forms provided by different fields and disciplines.

What emerges from the process is a fundamentally composite view that is conceptually more integrated and articulated as a whole than the view provided by any single perspective. For Goethe, these were never purely mental abstractions but essentially based on experience. Nor were they static conceptions but capable of modification as new forms were investigated through cycles of hypothesis, deduction and induction (Wilkinson, 1962, pp. 177-8). This paper has sought to apply this method to urban form itself by undertaking a deductive and comparative critical analysis of key texts from the different approaches to urban morphology. The result highlights that there are at least four broad types of aspect and eleven logically distinct general aspects:

- spatial relations of physical features
  - natural physical form
  - built physical form
- interrelations between humans and physical features
  - social and economic context
  - use/function/activity
  - control
  - intention
  - construction
  - perception
- flows
  - natural
  - human
- change
  - formation/transformation/cyclical change

At first sight this may appear unduly complicated. The provisional list of aspects must, however, be seen in the context of the

phenomena that we are seeking to understand. If we acknowledge that cities are almost intractably complex and diverse, can we expect to have a simple explanation for them that can be understood at a single sitting? The analysis shows there is a clear logical basis for the distinctions. If they are to have explanatory value we need to identify how they fit together in some coherent way, not just statically, but as part of a process of formation and transformation. And just as it is comparison that allows us to distinguish the aspects, it is further comparison that is necessary to determine how they fit together.

Identifying consistently defined aspects of form only clears the ground for and facilitates looking in more detail at the individual aspects, comparing them and investigating their interrelationships, associations and correspondences in order to identify the part they play in the processes of formation and transformation of urban form.

What is also clear from the results set out here is that further comparison and critical analysis is needed, especially on the aspect of physical form, not only to determine how it might best function as a reference key but also to ensure that our view of physical form is able to pick up the full range and diversity of specific forms and features and the relationships between them.

One starting point would be to confront the ambiguity that dogs particular features such as the plot and find their place in the overall structure of elements. Some initial work in this direction shows positive results (Kropf, 1996, 1997, 1998). Another starting point would be to fully acknowledge the different types of overall structure that can be identified depending on the base elements chosen as pertinent. The most obvious examples of different structures are the network patterns of linear features identified in the configurational approach, the patch hierarchies of morphogenetic regions in the historico-geographical approach and the modular hierarchies of the process typological approach.

Are these views mutually exclusive or can they be correlated by the use of a reference key for rigorous and consistent comparison? Using physical form as a common reference aspect to co-ordinate different descriptions of urban form would be a significant step toward building a more coherent understanding of human settlements. The alternatives would seem to be viewing human settlements as indistinct objects or sets of distinct but irreconcilable parts. If urban form remains monolithic we must be satisfied with a fascinating but ultimately mysterious phenomenon. If we separate aspects but leave them isolated and free-floating, we must be content with listening simultaneously to a number of unrelated conversations.

References

Batty, M. (2007) *Cities and complexity* (MIT Press, Cambridge, MA).

Burgess, E. W. (1925) 'The growth of the city', in Park, R. E., Burgess, E. W. and Mackenzie, R. D. (eds) *The city* (University of Chicago Press, Chicago) 47-62.

Calhoun, C. J. (ed.) (2002) *Dictionary of social sciences* (Oxford University Press, Oxford).

Caniggia, G. and Maffei, G. L. (2001) *Architectural composition and building typology: interpreting basic building* (Alinea, Florence).

Castex, J., Celeste, P. and Panerai, P. (1980) *Lecture d'une ville: Versailles* (Editions du Moniteur, Paris).

Castex, J., Depaule, J. C., Panerai, P. and Samuels, I. (2005) *Urban forms: the death and life of the urban block* (Architectural Press, Oxford).

Conzen, M. R. G. (1966) 'Historical townscapes in Britain: a problem in applied geography', in House, J. W. (ed.) *Northern Geographical essays in honour of G. H. J. Daysh* (Department of Geography, University of Newcastle upon Tyne) 56-78.

Conzen, M. R. G. (1969) *Alnwick, Northumberland: a study in town-plan analysis* (Institute of British Geographers, London) revised edn.

Conzen, M. R. G. (1981) 'Geography and townscape conservation', in Whitehand, J. W. R. (ed.) *The urban landscape: historical development. Papers by M. R. G. Conzen* Institute of British Geographers Special Publication 13 (Academic Press, London) 75-86.

Dennett, D. (1995) *Darwin's dangerous idea* (Penguin, Harmondsworth).

Eco, U. (1979) *A theory of semiotics* (Indiana University Press, Bloomington).

Goethe, J. W. (1952) *Goethe's botanical writings* translated by Bertha Mueller (University of Hawaii Press, Honolulu HI).

Gould, S. J. (1991) *Bully for brontosaurus* (Penguin, Harmondsworth).

Habraken, N. J. (1998) *The structure of the ordinary* (MIT Press, Cambridge, MA).

Helm, J. and Robinson, A. (2002) *GCSE Geography for AQA Specification B* (Heinemann, Oxford).

Hillier, B. (1996) Space is the machine (Cambridge University Press, Cambridge).

Hillier, B. and Hanson, J. (1984) *The social logic of space* (Cambridge University Press, Cambridge).

Hoyt, H. (1939) *The structure and growth of residential neighborhoods in American cities* (Federal Housing Administration, Washington DC).

Jacobs, J. (1961) *The death and life of great American cities* (Random House, New York).

Kropf, K. (1996) 'Urban tissue and the character of towns', *Urban Design International* 1, 247-63.

Kropf, K. (1997) 'When is a plot not a plot: problems in representation and interpretation', unpublished paper presented to the Fourth International Seminar on Urban Form, Birmingham, England, July.

Kropf, K. (1998) 'Plot types and housing in nineteenth century Westminster', in Petruccioli, A. (ed.) *Rethinking the XIXth century city* (Aga Khan Program for Islamic Architecture at Harvard University and the Massachusetts Institute of Technology, Cambridge, MA) 113-19.

Kropf K. (2001) 'Conceptions of change in the built environment', *Urban Morphology* 5, 29-42.

Levy, A. (1999) 'Urban morphology and the problem of the modern urban fabric: some questions for research', *Urban Morphology* 3, 79-85.

Lynch, K. (1981) *Good city form* (MIT Press, Cambridge, MA).

Moudon, A. V. (1986) *Built for change* (MIT Press, Cambridge, MA).

Osmond, P. (2008) 'An enquiry into new methodologies for evaluating sustainable urban form', unpublished PhD thesis, University of New South Wales.

Peirce, C. S. (1958) *Charles S. Peirce: selected writings* (Dover Publications, New York).

Putnam, H. (1995) *Pragmatism* (Blackwell, Oxford).

Slater, T. R. (1982) 'Urban genesis and medieval town plans in Warwickshire and Worcestershire', in Slater, T. R (ed.) *Field and forest: an historical geography of Warwickshire and Worcestershire* (Geo Books, Norwich) 173-202.

Stanilov, K. and Scheer, B. C. (eds) (2004) *Sub-urban form: an international perspective* (Routledge, London).

Steadman, P. (2008) *The evolution of designs* (Routledge, London).

Whitehand, J. W. R. and Carr, C. M. H. (2001) *Twentieth-century suburbs: a morphological approach* (Routledge, London).

Whitehand, J. W. R. and Morton, N. J. (2003) 'Fringe belts and the recycling of urban land: an academic concept and planning practice', *Environment and Planning B: Planning and Design* 30, 819-39.

Wilkinson, E. M. (1962) 'Goethe's conception of form', in Wilkinson, E. M. and Willoughby, L. A. (eds) *Goethe: poet and thinker* (Edward Arnold, London) 167-84.

The Codes Project

This project is a compilation of the codes, laws and related documents that have created, or sought to create, particular urban forms. 'Code' is broadly defined: it includes not only legal documents but also social customs – in other words, both legally-binding codes and customs that may not have involved a governing authority. These documents provide a rich resource for urban planners, architects and others.

A website had been set up (http://codesproject.asu.edu/) to which all are invited to contribute. Types of codes that are being contributed include unified development codes, architectural codes (building scale design regulations), building codes (health and safety regulations), state enabling legislation, design guidelines, pattern books and master plans.

Further information is available from Professor Emily Talen, Arizona State University, PO Box 875302, Tempe AZ 85287-5302, USA (E-mail: etalen@asu.edu).