

more common. Nevertheless, the transition from two-dimensional to three-dimensional representations of the urban landscape requires careful consideration of the costs and benefits of increasing complexity.

Bearing in mind the explicit focus of the process typological approach on the three dimensional aspects of the urban landscape, notably on buildings, what can point clouds offer to this school of morphological thought? How can point clouds deal with the distinction between visual form and structural form and with the process of formation grounded on the concept of type?

In science, but more particularly in the science of urban form, the availability of data is a major concern. While the limited use of quantitative three-dimensional geographical data in urban morphology can be explained by data limitations, an eventual increase in its use has to balance the needed resources for data gathering and processing with the potential for utilization in studies of urban form.

Point clouds offer urban morphologists a new perspective on cities. They capture the three-dimensional form of the urban landscape in a rigorous way, enabling the production of three-dimensional models of streets, neighbourhoods, cities and even countries. Future research should

help understanding of the data that urban morphologists extract from these models; how these data can be incorporated in existing morphological theories, concepts and methods; and the potential for the formation of new methods, concepts and theories in urban morphology.

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## Plots, formalism and the limits of the minimal

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Brenda Scheer's viewpoint (Scheer, 2018) raises a number of issues central to urban morphology as a discipline. It builds on her previous significant contributions over many years (see, for example, Scheer, 2001, 2016). Some of the points raised are specific to my previous paper (Kropf, 2018) while others are more general and relevant to the discipline as a whole.

The central focus of the debate is the plot or lot but extends to the way we define elements of urban form in urban morphology. More specifically, the issues appear to be: 1) whether 'form' only refers to physical objects or whether the term can be seen to encompass intangible aspects; 2) whether control (such as ownership and regulation) is an aspect of urban form; and 3) whether the term 'plot' refers

to both an element of control and an element of physical built form.

As argued previously in this journal (Kropf, 2009), I follow Kevin Lynch (1984, pp. 48, 345–58) in saying that urban form has multiple aspects, both tangible and intangible, one of which is control. I am fairly sure that Scheer and I agree on that point.

I think we also agree on the wider point that elements of one aspect should not be defined in terms of another. Most pointedly, we agree that a plot, *as an element of physical built form*, should not be defined in terms of use or in terms of control such as property ownership.

Where I become less certain is where I have ended up disagreeing and conflating the two. To

reiterate for clarity and certainty, one of the principal points of 'Plots, property and behaviour' and several other works (see, for example, Kropf, 1998) is to assert that physical built form and control/property are distinct aspects of urban form and that a physical plot, as an element of physical built form is distinct from and should not be confused with a plot as an element of control/property. This distinction between physical form and control is essential as the basis for saying, 'property boundaries are a socially agreed set of spatial limits on behaviour' (Kropf, 2018, p. 8). This is not to say that the two – the plot as property and as physical form – are not closely related. They clearly *are* and one of the aims of urban morphology is to investigate the interactions between aspects in order to understand better the formation and transformation of urban form.

Taking a step back, the idea of keeping the definitions of the aspects separate and stripping the definitions back to the minimum necessary is a move toward formalism or formalization. If we are to continue to move in that direction, which I believe is possible and desirable – but not without its hazards – it is necessary to acknowledge that no formal system can be defined entirely in its own terms. There must be some 'way in'. In mathematical formal systems such as set theory, that 'way in' takes the form of 'primitives': intuitive notions that are not formally defined within the system but establish the foundation for definitions. All the formal definitions that are subsequently constructed ultimately refer back to the primitives (Tarski, 1946) and, as Tarski later stated, a theory (see Patterson, 2008).

To follow this through (at least for the plot), we need to find two separate sets of primitives to build up the definitions of physical built form and control. Scheer does just this in her two definitions of the plot. On the one hand she says a plot, as a physical form, is *man-made*. On the other she says a plot as property is *claimed*. Appropriate to primitive notions, these two are not isolated attributes of form but the acts that *generate* the form. Both have their basis in a verb and are therefore about a *process: to make and to claim*. The difference between these verbs is at the root of the difference between the plot as a physical form and the plot as property. I *claim* a plot of land and then *make* the physical form of the plot by building walls and buildings and laying out gardens. And, the claims of my neighbours stop me from building on their land just as the claims of the community stop me from building on our common street. The

intangible claims limit the shape of the tangible physical forms. It is for this reason that the geometry of the *claims* is so important in the process of formation and transformation of the physical built form (see, for example, Kantarek *et al.*, 2018).

Again, to be clear, the minimalist approach must include at least two definitions of the 'plot', one as property and one as physical built form. We should also state openly that the aim of the minimal definition, following the principle of Occam's Razor, is to include the fewest number of elements and assumptions necessary to explain the phenomenon under consideration. This is not simplicity for its own sake but an effort to account for the widest range of phenomena and complex interactions with the fewest elements. In the case of urban form, that range of phenomena should encompass all kinds of human settlements, including those where: 1) there is no private property, such as in China; 2) there is a very different system of traditional, customary land rights, such as in pre-colonial Africa; or 3) there is a mixture of private property and customary systems, such as in present day Mongolia. We cannot pretend to *universal* definitions unless we include this full range. Which is why it makes sense to talk about 'control' rather than the more limited notion of 'property'. As Nicola Scardigno (2018) makes clear in his elegant and comprehensive study of Mongolia, we should be ashamed to dismiss entire regions and cultures and consider them to be outside the remit of urban morphology just because they do not have formalized records of property boundaries. It is not the records in themselves that are necessary to explain the phenomenon but the notion and acts of control – and their dimensions – as distinct from physical built form. Having the physical records does, however, make it easier.

A further requirement in seeking to establish universal, minimalist definitions is that the pertinent features we select for the definitions allow us to distinguish one kind of element from another. Measurability, which Scheer includes as another minimal attribute for defining plots, is certainly a universal attribute of physical objects (for example, land) but it does not help us to distinguish different *kinds* of object. We need to know what to measure. The significant breakthrough made by Goethe in establishing the discipline of morphology was to define forms in terms of internal structure and to define the elements within a structure in terms of their position relative to the other parts. Muratori, Caniggia, Conzen and others followed this through into the built environment. If we do

not use relations in our definition of form, in my view we will not succeed in understanding the structure, formation and transformation of urban form.

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## Urban morphology and architectural design: a contemporary condition

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The methods employed by urban morphologists, particularly in the Muratorian school, give emphasis to ensuring continuity in the transformation processes of buildings and fabrics. However, architects today have to deal with new aspects. In most European schools of architecture, knowledge is now transmitted mostly through evidence in the form of images.

Books and magazines have been replaced by digital technology. Many educators themselves have been educated through methods related to the culture of the image and communication. In support of this it is suggested that the image contains more information than the written text, although it has been proven for some time that this is not the case: the image may or may not contain a large amount of information depending on the conceptual and theoretical tools utilized, and these can only be transmitted through theoretical texts (Russo, 1998). Nevertheless, teaching tends today to deal directly with the relationship to form without the mediation of a rational method. The task of solving a problem has generally been replaced in architectural teaching by performing

a series of practical steps often derived from the visual arts.

However, the rational components of the design become increasingly complex. The principles of classical economic science, largely based on the simplifying hypothesis of the perfect rationality of individuals, have long been in crisis. This is because of the evidence of the phenomena in progress, linked to the uncertainty of environmental transformations and social changes, and to the attempt to stabilize them through the constraints (informal constrictions and formal rules) of the institutions (North, 1990). Flexible design methods suitable for fast changing global conditions are also needed. For all these reasons, our studies aimed at the existing built environment are often considered as not entirely appropriate for innovation and in some way outdated.

It is important therefore to make clear the positive role of the discipline of urban morphology in the current phase of crisis, in which architecture seems to be much more oriented towards communication than to building. It is necessary to make clear that Muratorian urban morphology can