

Urban Space Planning for Sustainable High Density Environment

Nicolas Ladouce¹, Limin Hee², Patrick T. Janssen³

¹ Doctoral Candidate, Department of Architecture, National University of Singapore,

^{2,3} Associate Professor, Department of Architecture, National University of Singapore

¹nicolas@nus.edu.sg, ²akiheelm@nus.edu.sg, ³patrick.ht.janssen@gmail.com

Abstract. *In this paper we investigate the possibilities of new typologies of urban public space for high density environments. The premise for the project would be that with new high-density typologies, it would be necessary to consider a difference in the nature of urban public spaces rather than a difference in degree from the status quo. From observations of urban patterns that drive collective, hybrid spaces around Asia, relationships between urban attributes are drawn. For this paper we shall focus on the particular case of Linked Hybrid, Beijing, China, as an elevated urban public space. A literature review focuses on reviewing key theories to construct and adopt a rating system to develop an empirical framework to evaluate the case studies and extract the key attributes. These rated attributes are then abstracted in a real-time model that enables user manipulation. The purpose is to create a tool to better observe the effects and evolution of planning decisions for future urban spaces in high density contexts. The preliminary results are consistent with the idea that selected spatial parameters of a space may be embedded into a “barcode” and referenced as a type. The combination of different types, hence their parameters may be used for effective replication of their characteristics to improve the decision-making process for urban designers. The research is not intended to reproduce the successful urban public spaces but rather result in a catalogue of typologies which can be referred to during the initial stages of planning to provide an indication of spatial qualities.*

Keywords. *High density environments; collective urban space; hybrid typologies; parametric urbanism.*

Introduction

The main impetus for this project is that high density spaces would require qualitative re-orientation of the conception of urban public spaces, rather than mere quantitative re-adjustments. Investigations are

made of possible new configurations of urban public spaces integrative with high density typologies that are environmentally considered, and have the potential to be socially adapted to become vibrant public spaces. The premise for the project is that with new high-density typologies, it would be necessary

to consider a difference in the nature of these urban spaces rather than a difference in degree from the status quo. The research is supported by generative and parametric tools to provide designers with a system to investigate new typologies in high density contexts. This paper documents the first experiments towards developing this system.

Problem Statement

Urban Public Space as “Collective Space”

Public space can be defined an accessible space for all urbanites regardless of gender, race, ethnicity, age or socio-economic level with free circulation of persons and goods Gehl (1936), Carmona (2003), and Shaftoe (2008). Classical definitions of public space also describe it as a space of debate, a symbol of democracy and sociability. Finally, urban public space is as an open space to cater to public health and recreation purposes.

The notion of space as “collective space” presupposes that groups occupy domains and co-exist on a competitive basis with other groups. Interactions between groups may be spontaneous, but differences exist and may at times lead to antagonism. Collective space tends to be more social than political in nature, and may approximate the marketplace more than the agora. The “experiential” rather than communication dimension of public space is foregrounded. This would be the definition adopted for this research as urban (public) space rather than the classical definitions, due to the emphasis on the physical nature of urban space and its applicability in the Singapore context. The term “urban space” is used instead in the research to take into account spaces that may not be public-owned but perform like public spaces.

Hybridized Typologies

Familiar models of urban space include those predicated on the relationship between the form of urban space and the use and socio-cultural meaning

of these spaces in the development of typologies. Squares, boulevards, public gardens and arcades had not only made the city readable, but held meanings and uses that were understood by everyone. While previous research has focused on such typologies, we still know too little about the expanding typologies emerging today. The increasing cultural diversity of cities is leading to a multiplicity of hybrid space typologies.

It is necessary to examine the shifting meanings and use of places over time, the deformations of typologies of spaces, as well as the importation of new typologies and their reconstitution in high density contexts would be more relevant to the needs of new high density environments than to review a history and taxonomy of types of public spaces. In selecting the case studies, we have therefore prioritized emerging new uses in existing typologies of public spaces in high density contexts and attempted to categorize them as follows:

- Multi-level, multi functional spaces (emergent uses railway stations spaces as public space)
- New types of urban spaces in Intensified residential developments
- New types of urban spaces in urban districts and integrated development
- Urban spaces in integrated waterfront districts
- Elevated urban spaces
- Pedestrian friendly planning in cities
- Urban green

While the themes used to categorized the types of spaces above are not hybrid per se, our interest lies in spaces that have been transformed in terms of new uses and activities over time. For this first experiment, we shall use the example of an elevated public space.

Framework

Urban attributes and their relationships

Cities can be seen as a dynamic assembly of events that functions together synergistically. Over time,

elements of the city function as dynamic organisms, changing in response to how people interact with them. Through the case studies, the research deconstructs the selected typologies of urban public spaces to explore the relationships between sets of attributes to identify and understand the nature of their formation, functions and feel. Urban spaces are described often by broad intangible qualities such as comfort, aesthetics, etc. These qualities can be further broken down into measurable aspects that define space, or by their defining attributes. Many attributes may be involved in defining an urban space.

Drawing from research by Gehl (1936), Carmona (2003), and Shaftoe (2008), attributes defining urban spaces include connectivity, accessibility, privacy, user density, active frontages, demography, and intensity of activities etc, many of which have linked relationships with other attributes. It is expected that these relationships may be asymmetric & varied - e.g. better connectivity of a particular space may be one of the factors that account for an increase in user density and an increase in the intensity of activities. Through the collection of data from our case study, we examine the relationships between attributes as well as the typologies of spaces defined by specific sets of attributes. These relationships are later reconstructed in a parametric model.

Research Background & Methodology

Advances in digital tools and processes have radically revolutionized the design, practice and construction of architecture in the past decade. Generative and parametric techniques have demonstrated their versatility in architecture through their ability to integrate variable aspects such as time, sun exposure, wind patterns and spatial trajectories into a digital design process. However, in the past few years, there has been a slight shift in the usage of such tools and processes to explore their potential at the urban scale. The ability to simulate and evaluate the implications of design strategies over time is a key attribute for which the use generative and parametric

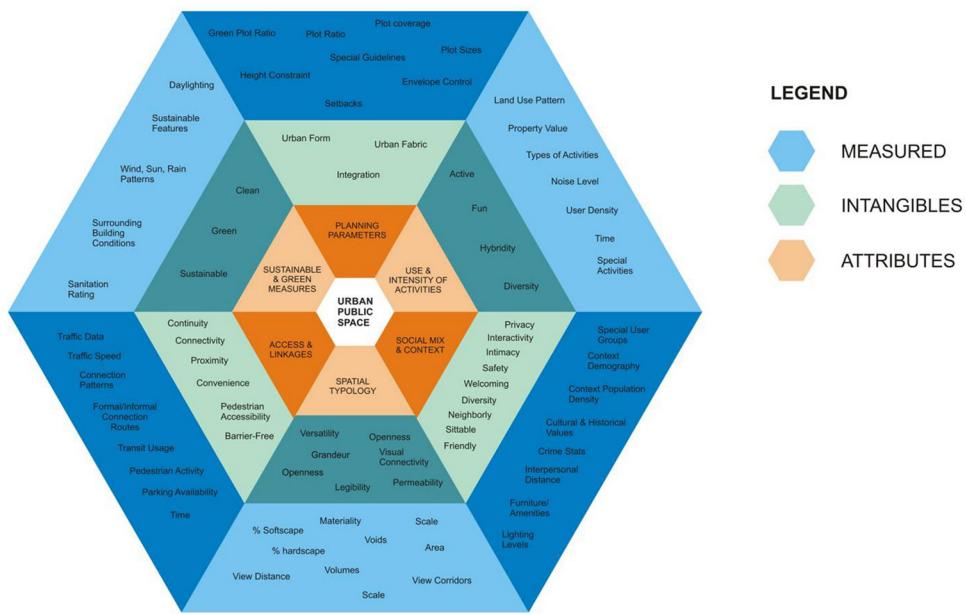
tools have been welcomed in urban design .

As Patrick Schumacher explains in his manifesto on 'parametricism', parametric modeling techniques have pushed the barriers of designers for the past decade enabling a certain style that very much governs form finding today, be it in design or architecture. While Schumacher's call revolves around the beginning of a new aesthetic to replace modernism, it is undeniable that parametric and generative tools can achieve more than form making or aestheticism. They have the potential to provide a framework for an integrative design process.

The use of recursive algorithms (Cellular Automaton, Voronoi, L-systems) have made it possible to adapt modeling techniques at a bigger scale: that of the city. These algorithms are capable to articulate the inherent programmatic complexities of city systems such as transport, zoning regulations & design guidelines. The integration of generative and parametric tools in Urban Design has been welcomed by two major changes in theory and thinking of urban designers. Firstly, planning ideals in the last few decades have shifted from the idea of master planning to strategic planning, where the process consist of the implementation of the planning concepts itself rather than the drawing of the master plan. This calls upon frequent interventions to adapt to the changing patterns of the urban environment. There is a need for planners to be able to keep ahead of changes and to constantly evaluate the consequences of their action. Simulations and parametric modeling offers that kind of flexibility. Furthermore, they have allowed designers to extrapolate the simulations to assess the implications of their ideas without having to wait decades for them to be fully implemented.

Secondly, these tools have allowed designers to unleashed new design processes and new forms that are more integrated, especially as we begin to understand cities as environments that function in real-time, where entities are dependent and self-organizing with emergent potential. The objective of this research is to look into these algorithms as tools to synthesize, analyze, combine and evaluate

Figure 1
Urban attributes adapted
from PPS (2008), Gehl
(1936), Carmona (2003), and
Shaf toe (2008)



attributes of existing and new typologies of spaces.

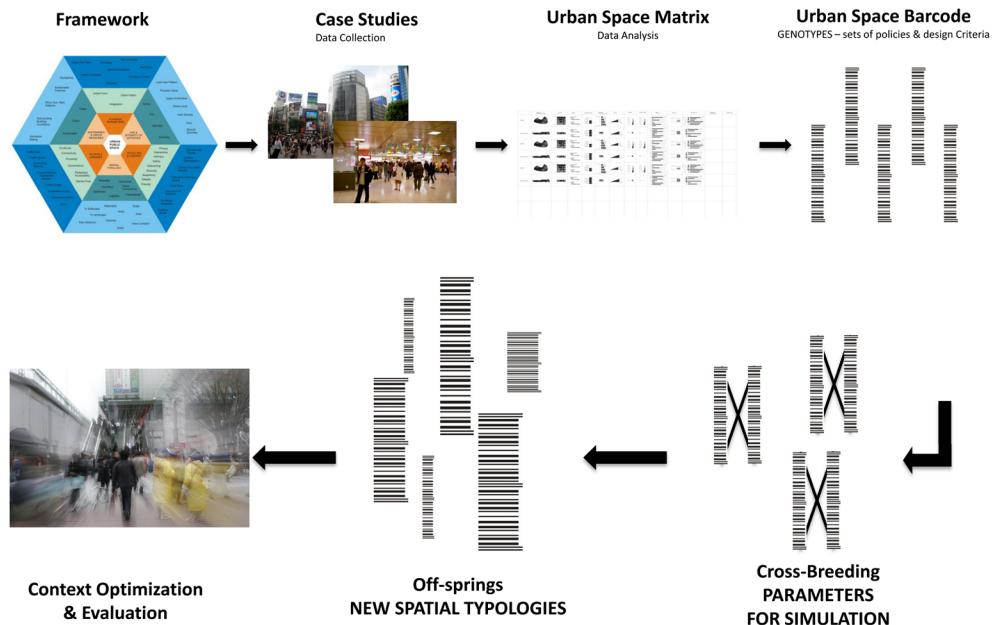
Methodology

The research is carried out in two parts: the first part is a case study based design survey of selected typologies of urban spaces in high density contexts such as New York, Beijing and Tokyo. This study includes documentation of typologies, uses, intensity of activities, with a comprehensive documentation of the design parameters and planning policies, including measures to enhance sustainability capabilities of the larger urban environment. The aim is to highlight and define the key attributes that has contributed to the use of this space as a "collective space". The following illustration [Figure 1] shows the relationship of some qualities of space with the expansion into measurable attributes. However, the study captures only key attributes that would form the basis for

describing most urban spaces.

Linked parameters define specific urban spaces, such that these parameters can be used to identify particular types of spaces. These linked chains of parameters may be described analogically as spatial "barcodes," since they derive the signature of a particular typology of space. A barcode will encompass the relevant parameters as well as their inter-relationships that are instrumental in shaping the type of urban space. The stringed spatial barcode, with their quantified parameters can be used in an evaluative framework in comparison with other spatial typologies defined also by these barcodes [FIGURE 2]. The results are evaluated and recommendations made on the parameters for new urban space in local conditions based on the implications of designing within the new high-density context.

Figure 2
Research process



Linked Hybrid as a Case Study

For reference in this paper we shall be using the Linked Hybrid residential development by Steven Holl, as an elevated urban space. The Linked Hybrid is an integrated residential development, situated to the north-east side of Beijing on the fringe of Dong Cheng District. It is particularly acclaimed for its integration of sustainable features such as geothermal energy for cooling or heating.

The design aimed to promote interaction through its porous and generous urban space around and above in the development. Through a mix of commercial, educational, residential and recreational uses at different levels, it aimed to bring in people from the surrounding to generate a micro-urbanism that would be in contrast with the current privatized urban developments in China. The first

floor features cafes, bookshops, interior décor offices, hotels, shops, cinema and a gymnasium.

Elevated urban space - Sky Bridges

The sky bridge is a unique ring of bridges and urban spaces that links all the 8 residential towers together from ranging from the 12-18th floor. 3 dedicated lobbies provide access to the sky bridges via express lifts. The sky lounge programs include bar, restaurant, gallery, bookstore, lounge, swimming pool, sauna, gym, spa, and shops. While the conceptual idea is refreshing, its implementation is not successful and begs the question whether the location is adequate.

Analysis of Linked Hybrid

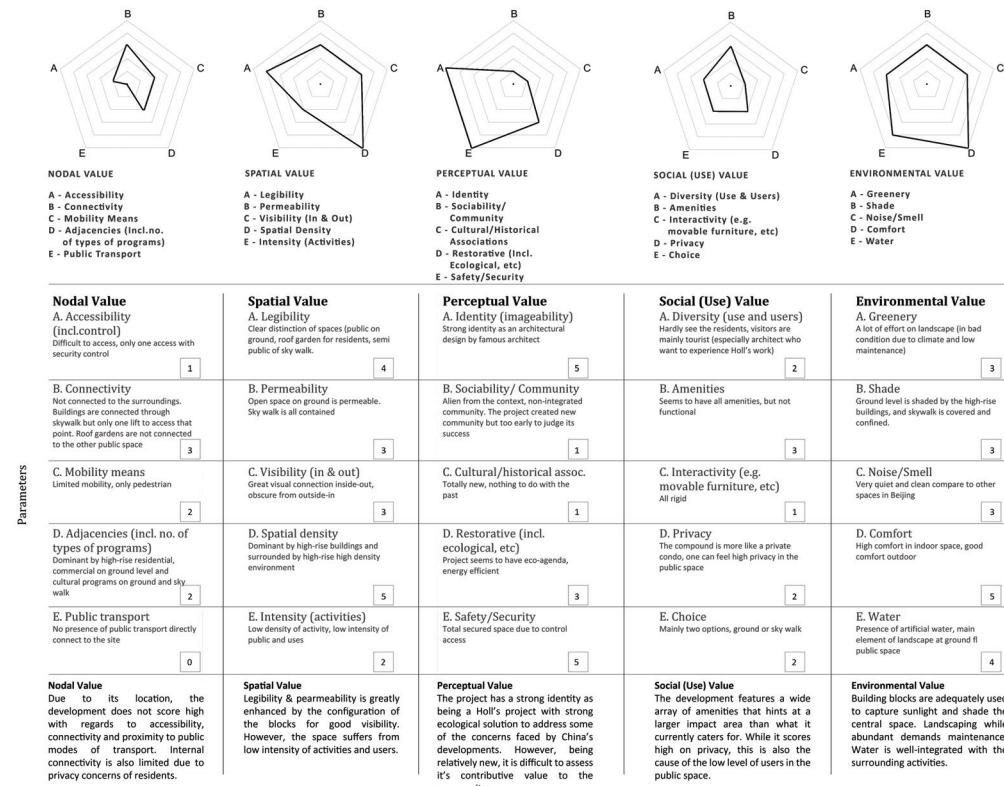
Highlighted below [Figure 3] is a rating table for the key attributes of Linked Hybrid urban spaces. As expected, the Nodal Value for the development is deficient. If the sky bridges presupposes the failure of elevated urban spaces, the development's location and its gated typology plays a major role in its eventual demise. We shall thus consider the potential positive aspects that sky bridges, as a new type, can generate in a high density setting; mainly linking developments, creating a continuity of the street up in the sky and capitalizing on views/vantage points offered in a high rise context.

There are a number of variables that may be

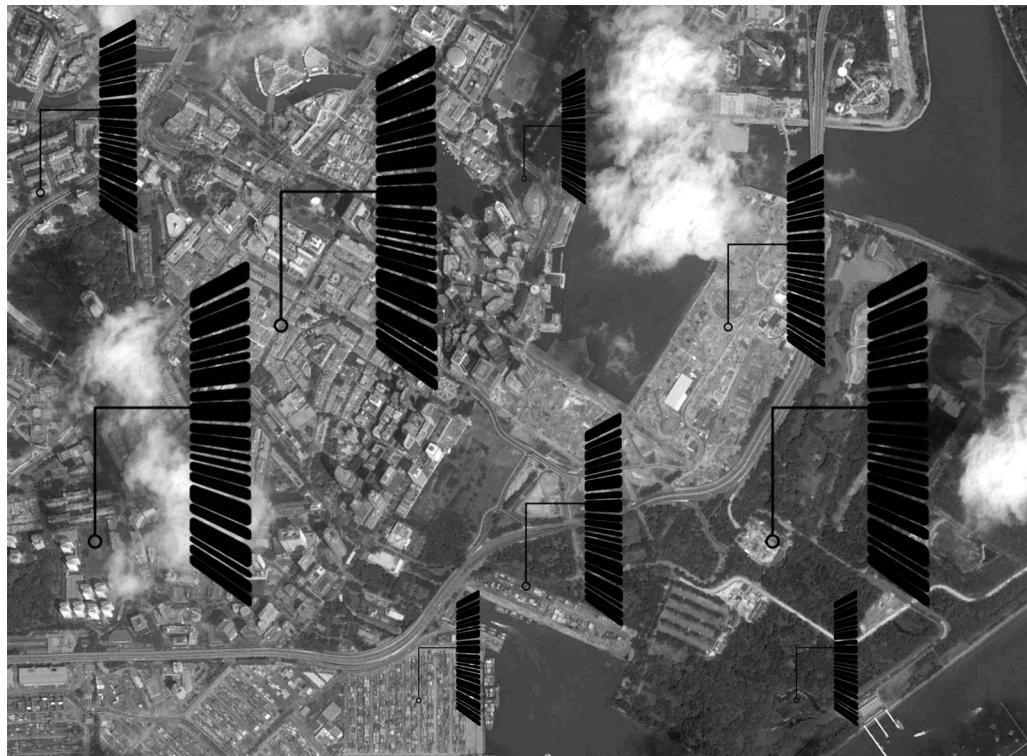
employed to generate the typology of Linked Hybrid; however for now this will be restricted so as to generate the main physical and spatial attributes. Below is a list of the variants identified to generate the elevated sky bridges of Linked Hybrid:

1. Building Plots
2. Existing Building Footprint
3. Height of Buildings
4. Distance between buildings
5. Height of Bridges v/s height of buildings
6. Bridge inclination less than 1:20
7. Bridge width & depth
8. Points of connection

Figure 3
Key attributes of Linked Hybrid urban spaces



*Figure 4
Diagrammatic spatial barcodes representing the particular typology of a space*



Tools & Techniques

Modeling of Urban systems through relationship of attributes

Linked parameters define specific urban spaces, such that these parameters can be used to identify particular types of spaces. These linked chains of parameters may be described analogically as spatial "barcodes," since they derive the signature of a particular typology of space. A barcode encompasses the relevant parameters as well as their inter-relationships that are instrumental in shaping the type of urban space [FIGURE 4]. The parameters of a barcode are extracted from the key attributes of the particular space.

This initial phase has been developed using Rhinoceros 3D and the graphical algorithm editor, Grasshopper. A relationship model is set up between the design variants identified above. These are related by one or several mathematical and probabilistic relationships to continuously generate multiple design variants.

For this first experiment, a hierarchy is established among the variants from user-defined plots to generate the number of floors for a particular building according to manually configured entries for plot ratio and site coverage. A test is implemented to locate the most efficient connecting points based on the shortest distance between building facades. This results in a number of possibilities than can be optimized by manually changing certain values such

as the height at which the bridge occurs, bridge inclination, width, depth and changing the points of connection. Using this simple setup, an array of variant can be generated and evaluated as previously shown in Figure 3. This rating system is currently done manually based on a set of criteria based on literature reviews. It is our aim to automate this evaluation process through the use of evaluating tools such as space syntax for instance.

Results

Figure 5 below shows some of the first variances created with the parametric model.

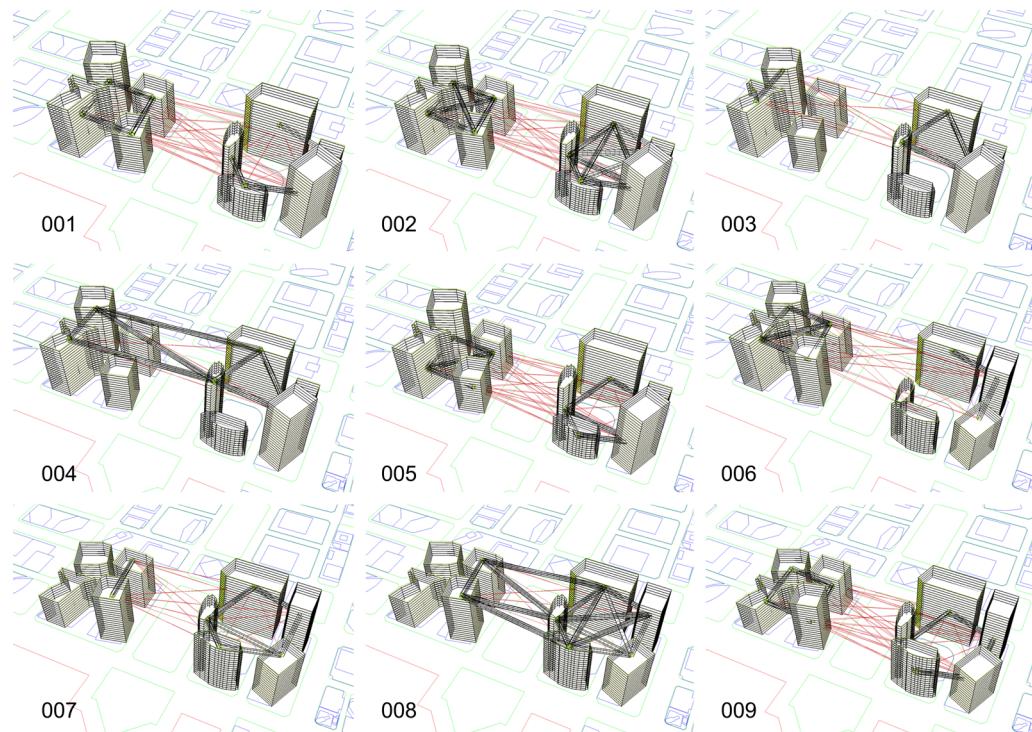
The string of relationship obtained above, while still in its crude form becomes a barcode for the generation of elevated spaces types. The objective is to

create variations of this elevated space barcode typology as well as other types discussed above. The purpose is to create a catalogue of barcodes from which designers may then cross-breed to generate new hybrid types.

Conclusion and Further Work

Modeling new typologies

The preliminary results above are consistent with the idea that selected spatial parameters of a space may be embedded into a “barcode” and referenced as a type. The combination of different types, hence their parameters may be used for effective replication of their characteristics to improve the decision-making process for urban designers.



*Figure 5
Variances generated from the particular sky bridge typology*

The next step in our work will be to develop a coherent and well-defined framework to guide our modeling process in terms of functionalities and techniques used to move from simplistic to more complex relationships between urban attributes. The stringed spatial barcode, with their quantified parameters can be used in an evaluative framework which will have to be integrated to validate the variants generated and automate the rating system for attributes as privacy, connectivity, visibility through the use of agent-based simulations. The cross-evaluation enables us to place different typologies of spaces within a ranking system. Simulations of spatial typologies enable the parameters within the barcode string to be varied, engendering yet other new spatial typologies in the process.

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