Parametric Urbanism as digital methodology

AN URBAN PLAN IN BEIJING

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ABSTRACT:
Evolution and innovation in architecture are intensely related to the rise and developments of technology. Within this context, it is possible to recognize how in recent decades this milieu has fostered the development of new methodologies for urban design and architectural practice, as is, for example, the Parameterization. This paper is focused on the subject of Parametric Urbanism: discussing / questioning the emergence of this new architectural methodology; addressing the factors that contributed to its appearance; and seeking to understand whether the parametric approach has benefits and whether it may or may not be a solution or of assistance to urban planning. The paper provides a brief literature review focused on parametric urbanism and then it presents a practical case study of parametric urbanism: an Urban Plan in Beijing, developed in an academic context, at the University École Polytechnique Fédérale de Lausanne in 2012. Having as base diverse examples of parametric urbanism, it is tried to identify/justify decisions defining principles and application guidance for this project. The conclusion presents the final considerations based on opposing the case study with the theoretical approach, seeking to clarify whether this new kind of urban design methodology, Parametric Urbanism, is or not viable.

KEYWORDS:
Parametric Urbanism; urban design; urban design methods; sustainability urbanism; Parametric digital tools.
1. INTRODUCTION

When we look at the past twenty years, it is possible to verify an impressive development in architecture regarding technological and digital means. The computer-aided design (CAD) has become an indispensable tool in the practice of architecture and is, in everyday light, in all architecture offices. The interest for the development of CAD technology and its application in architecture dates back to 1962. We can point out as one significant example of a theoretical studies on this matter, the work of Ivan Sutherland, developed on his PHD thesis, where he discussed a greater interaction and relationship between Man and Machine (Sousa, 2010, pp.35). José Pedro Sousa argues that since the firsts studies until today it is possible to denote four distinct phases of the technological development applied in architecture, verifying the growing importance of digital tools over the last decades:

1. Emergence and expansion of digital design in architecture in order to facilitate and make more efficient the production of technical drawings, however the computer still had little relevance in the project development.
2. Software was already capable of three-dimensional modeling which allowed, in architecture, the generation of virtual models as an alternative or complement to existing physical models, making even easier the presentation and visualization of projects.
3. Digital technologies presented new conditions for the development of the project, playing an active role in its conception. Development of parameterization, directed to architecture, was an alternative methodology in which the digital progress started to play an essential role in the realization of projects.
4. Developments in digital processes enabled the appearance of computer controlled manufacturing (CAAM), where human intervention is not necessary during the materialization process and all the required information for the construction is given by digital models, meaning an increased accuracy, precision and customization of what is made. (Sousa, 2010, pp.37)

The progressive development of digital technologies and its resulting increase of investments is showing that digital tools and the related processes are increasingly important in architecture by offering potential adaptation and addition to traditional methods and processes (Sousa, 2010, pp.40). At present days, the process of designing a project is more efficient by introducing the possibility of dynamic creation of architectural pieces through digital drawings. The CADCAM tools redefined the relationship between design and production by integrating the entire architectural process, from the development of the idea to its construction, allowing the projection and manufacturing of architectural artifacts resulting from digital data (Silva, 2010, pp.38). Until a decade ago the development of parametric tools capable of interactively modeling digital objects was still lacking, tools that would enable to modify interactively a digital model aiming to improve design flexibility (Silva, 2010, pp. 39) were an exception in architectues everyday offices. They stationary relied on traditional methodologies in architecture design process, where the computer was used just as tool of representation. However from the last decade CAAD software ceased of being a simple tool for representation and became an instrument of fundamental value in the invention and creation of an architectural design project. Since that moment to the present it has begun to emerge, in architecture, new concepts linking technology and the digital world, producing new design processes less dependent on traditional methods. This evolution resulted in the emergence of the new procedures, such as the creation of topological spaces (Topological Architecture), the use of isomorphic surfaces (Isomorphic Architecture), cinematic animations (Animated Architecture), the use of fractal geometries (Fractal Architecture) and the development of projects through the use of parameters and generative algorithms. This last development contributed to the rise of Parametric Architecture (Stavric & Marina, 2011, pp.10).

Motivated by the potential that Parametric tools could offer to the practice of architecture, there have been intense technological investments on this area in the last decade, resulting in an increasing amount of advances in the development of parametric tools for architecture. The parametric systems differ from the traditional ones by adding to the model the ability to change, during all the design process,
allowing the production and experimenting of several versions of the same, within a controlled design environment, by simply changing the values of specific parameters (Silva, 2010, pp.42). Nevertheless, it's important, in context, to evaluate the capabilities and benefits of parametric tools in the practice of architecture, analyzing the implications of using this more dynamic and interactive methodology for architectural design project. (Schumacher, 2008).

2. PARAMETRIC URBANISM

The Recognition of the Parametric tools potentialities for the practice of architecture brought an intensification of technological investments on this area in the last decade, which resulted in an increasing amount of advances in the development of parametric tools for architecture. The progress of these technologies for architecture has grown in two different directions, originating the constructive parametric method and the conceptual parametric method (Stavric & Marina, 2011, pp.11). The conceptual parametric method makes use of generative algorithms to create and control formal aspects of digital elements in architectural design projects, where most of the parametric software available has a graphical editor of algorithms related to the digital model. However, it's important to analyze the implications that this dynamic and interactive methodology brings to design projects, evaluating the capabilities and benefits that parametric tools have for architecture practice. (Schumacher, 2008).

Since the beginning of the first experiments of using parametric tools in architecture design process, it has became clear that these tools could bring similar benefits to Urban design Projects, having even effectiveness in higher scale urban cases (Nagy, 2009, pp. 14).

Within Parametric Urbanism methodology, classic Geometric Shapes drop leadership for its obduracy and difficulty to adapt to different problems and are replaced for more intuitive, adjustable and intuitional solutions (Leach, 2009, pp.19). Therefore, we can say that the Parameterization has its own rules, methods and features, rejecting static or rigid solutions, taking into account the variables as lively, dynamic and mutable elements of the urban system, linked to the constant needs of adaptation of urban design project. (Kolarevic, 2000). In a parametric urban design project, geometries are created to be strongly related with all other design elements, where a specific variation will lead to a consequently adaptation response in the model, creating a very dynamic and interactive urban plan solution, interconnected and related to all variables of the urban system; each active variable changes, through the system variations and the current model generates changes in the urban proposal, without losing the consistency and integrity of the previous model.

With Parametric Urban, the design of solution is no longer conducted by axial forces or position of urban objects, but is guided by the distribution of densities of constructed urban fabric, by the sensitivity to deformations along the territory or by the development of compositional gradients (such as the transformations on the heights of buildings), understanding space individualities that define the city.

Presently we can point out several examples of architects that study, explore and promote this new architecture approach in their works. Zaha and Architects are a clear example of those who are notably contributing to the emergence and development of this new style. Also Patrik Schumacher writings (Schumacher, 2005; idem, 2008a; idem, 2008b; idem, 2009; Leach, 2009) are a substantial theorical contribution for the study and discussion of Parameterization, supporting the validation of this new model of urbanism. For Schumacher and Zaha Hadid, the Parameterization applied to Urbanism is a method with a great potential to be explored, arguing that with this new methodology, the design process becomes much more dynamic and interactive, where the systems that make up a city are interconnected and related with each other. These ideas are clearly present in their several urban design proposals such as ’One North Masterplan’ or ‘Thames Gate Masterplan’.
By understanding the growing potential of Parametric tools applied to the scale of the city, we can see the work developed in recent years by this team of architects as a clear example of experiments seeking the exploration and development of this new architectural language mainly in the field of Urbanism. Their approach has contributed to formulating new concepts and development of a new design processes in architecture and urbanism (Silva, 2010, pp. 47), proving Parametric Urbanism relevance as a possible solution to urban design solutions.

2.1 ZAHA HADID
One North Masterplan, Kartal-Pendik Masterplan, Thames Gateway

The project One North Masterplan, by Zaha Hadid and associates, represents a significant reference on behalf of one of the first examples where parameters were applied to urbanism as a procedural method. In 2001, this urban plan was the winner in the international competition for an urban plan for an industrial zone in Singapore, located in the peripheral east zone of the city.

Understanding the potential of the parameterization in urbanism, such as the ability to quickly view any changes made in the design proposal and the easy ability to control data from the urban model, the parametric methodology was seen as a clear consistent choice. In the process of creating the project nothing was decided by chance, even if its visual may tell otherwise. The design of the streets is not a random result: the gently bending pattern, designed using NURBS, defines the position of roads and paths, and formal deformations applied to the buildings allowed a mediation and integration of various pre-existing urban networks. As Zaha Hadid stated (Schumacher, 2004, pp.45), this is the great advantage of working with free forms that are liable to be deformed, as opposed to platonic forms for being rigid and static. Free forms can be changed at any time during the design process by allowing its own modification and formal degradation in response to subsequent adjustments. However, it is not the lack of Platonic values that makes this system less consistent and sustained; it is a system and methodology that is no more unreliable than others more traditional. The ability to absorb further adaptations, or existing features in the design, will guarantee unity and identity to the creation process. Given the widespread impulse to criticize this project approach as crazy and unreasonable, much due to aesthetic factors of urban plans, Schumacher (Schumacher, 2004, pp.18), defends this methodology by its capability to generate adaptable compositions and promote continuity in the projects, in addition to being a plausible solution when solving complex programs.

The Project, in the middle of an industrial area, is perfectly fitted into the different grids adjacent to it, where the architect explores the curvature potential, the shape deformation and the flexibility of the options given by the parameterization. Because of the complexity of the program presented and the huge quantity of factors and limitations existing on the spaces to be taken into account, the office decided for a digital approach. Parameterization was used in order to answer the need to manage and control a big data base, where a fast and automatic visualization of the changes in project were vital. The group’s solution was to use parameters as the base method in the process, where the numeric data and the digital tridimensional model were directly linked in such a way that the modifications made in one of them would influence the behavior of the other. (Silva, 2010, pp.64). By creating parameters, the project acquired the desired design flexibility and Hadid could set and change data such as area, density, flow, contextual and formal constraints, always with the possibility to create relationships between them. With parameterization, the architect has achieved a great formal cohesion and aesthetic coherence in the relationship between the new and the existing.

When creating urban spaces with diversified programs, the architect desired to avoid the zoning of services and activities, characteristic very present in modernism and the parameterization proposes to resign. The consequences from a programmatic mixture in an urban plan will lead to, as the author explains, a better social vitality, where the urbanization becomes more dynamic and socially efficient. Given the complexity and diversity of urban networks on the site, the use of parametric tools was essential in order to manage a lot of factors to create meshes and urban masses capable of great flexibility and to be tolerant to adaptations. This methodology enabled the adequacy of the plan through existing
Another project that makes use of parametric methods in urban design and shares common authorship of the above mentioned is the Kartal Pendik Masterplan, developed in 2006. With an interval of five years between the plan designed for Singapore, this seems more mature in the development of the parametric method in an urban plan. The project gets its name by connecting and qualifying an urban area that connects the regions of Kartal and Pendik, located in Istanbul. In the project, we can check that the design of existing grids in these two regions, served as basis for proposing the definition of a slightly deformed urban grid that promotes continuity of the existing main roads. In addition to the proposed pathways that give greater unity and identity to this urban area of Istanbul, the project also offers a wide avenue that crosses those, creating a network of roads that connects the city to other Asian and European countries.

The combination of transverse and longitudinal pathways present in the plan will result in the creation of a grid with adaptable properties that suite to the terrain and other topographical conditions. Silva (2010, pp.66) names this grid as elastic grid, since the grid is extended and deformed to form urban area. In certain regions, the grid deforms to create a network of towers in the open landscape, in other areas is inverted to become a denser fabric, and in other conditions it can completely fade away to generate green parks and open spaces (Silva, 2010 pp.66). For the buildings proposed in this project, Zaha Hadid (2006) explains that both articulation, such as the creation of different types were obtained through methods of script, where buildings and their features - formal and functional – were created to answer the demands of each of the seven districts of the urban plan. (Hadid, 2006)

In this project we can state that, as opposed to One-North Masterplan, the project presents a grid structure as the basis of the masterplan's organization. In modernism, the use of Cartesian grids for organization of space was very usual, however the Kartal-Pendik grid in this masterplan is not Cartesian but topological. This means that the streets and axes will shape and adapt according to the terrain features and other exterior conditions, in order to facilitate access and promote connections.

With the Thames Gateway Masterplan, in London, the architect Hadid used a parametric methodology much more experimental than the previous masterplans she developed. In the project, developed in 2007, it is proposed an urban regeneration methodology for the area based on the study of elements like residential buildings, towers, horizontal buildings and urban blocks present in the capital. (Silva, 2010, pp.66). After analyzing these architectural elements from London, they were associated with a distinct geometric element: point, line, plane and volume, respectively. Using parametric modeling tools, the designed composition of these four types were actively related to adapt to external conditions. Despite the masterplan presented a strong emphasis on the aesthetic features of the proposed elements, the project showed some capabilities offered by digital tools such as parametric techniques, allowing controlled and logical proliferation of intuitive organization that created an urban model able to evolve in its form (Silva, 2010). The same method was applied on an urban model able to modify and adapt to the conditions present in the peripheral region of Beijing. After the analysis of the architectural elements in Beijing, the model proposes to maintain architectural features found in the traditional zone but also to react to the parameters that have been associated, allowing flexible design to examine and evaluate a large ste of variations for the project. (Whitely, 2007, pp. 12)

The parametric properties presented in the projects shown made possible an extreme adaptability to proposed models that can transform at any time in its development, without the loss of formal coherence. This feature is unique to parametric processes, where the control of variable parameters will result in the generation of multiple solutions that relate to specific conditions of the moment. The adaptability of an urban plan may be relevant during the years in which this same plan is applied - an advantage to be taken into account since urban plans need a long time to be done.

The work of Zaha Hadid presents itself as an indispensable reference in this area. With the latest masterplans of her team, together with the theoretical contribution of the authorship of his partner
Peter Schumacher, among others, it became much more coherent and consistent the approach and experimental practice of urban parameterization, like the case of the project conducted within the studio. Their projects may show some aspects which were previously seen as radical and violating the logic of an "effective architecture". If they are consistent and coherent, they become strategic key elements in the spatial organization and articulation. Moreover, the use of parameters applied to the present Urbanism is still seen as a fragile method and unreliable due to its aesthetic characteristics and capacities, and this fact often taken as priority.

3. PARAMETRIC MASTERPLAN IN BEIJING

In this section it is presented a case study of parametric urbanism of an Urban Plan in Beijing, developed in an academic context, at the University École Polytechnique Fédérale de Lausanne in 2012.

The goals to achieve in urban design project were explicit: research and find new strategies and urban solutions to control the new Masterplans and deliver sustained growth both to residential, commercial and social, as well as finding solutions for people alimentation. The concern for food production makes sense when current resources are insufficient to answer to the needs of population growth like in Beijing, consequently, it was essential to predict the combination between urban design and the creation of agriculture spaces.

Once the capital of China is already a consolidated and well structured city, it is still possible to exist an urban expansion beyond the sixth ring of the city, where Beijing is expected to expand to South
and East in the next decades. A possible new urban arrangement can be the creation of satellite cities, sustainable and autonomous, as well as the expansion of small towns and villages that are already on the outskirts of Beijing. Since the application of new urban plans in the region will be a long term process, this work became a perfect opportunity to deepen and explore the Parametric Urbanism.

The methodology used in the development of the design proposal for Beijing had as benchmarks Zaha Hadid’s work that was presented in the previous section. From One North Masterplan, it is important to note the great flexibility that it has to relate to the pre-existence. This project was a relevant analysis since the project proposed for Long Qing Hu region is an expansion of a small town in the existing zone. Its growth and revitalization is relevant and useful for urban development being a town with a route connecting to the railway which connects the capital. Apart from the formal flexibility in One-North Masterplan, we can also highlight the diversity of building typologies achieved using parameters. The existence of a wide variety of architectural elements, where we can find in the same masterplan tall and low buildings, wide and thin, is a major feature of the plan to reconcile so many different elements together and still promote unity and cohesion of urban design. This diversity of elements is also found in Long Hu Qing project where any proposed building is unique and no other shares the same shape. Despite this diversity and uniqueness of elements, you can check in the project a sense of unity and cohesion, one of the properties of the parameterization ability to achieve unity through diversity.

The second project of Hadid also provided a significant contribution to the development of the project in Long Qing Hu. As already discussed, the Kartal Pendik Masterplan uses a topological grid designed parametrically allowing an appropriate adaptation to the land where the project is proposed. Similarly to the plan designed for the area of Istanbul, the project developed in the outskirts of Beijing is also sensitive to environmental parameters. The area of intervention is very limited due to the natural characteristics of the site. With the existence of a river by east and north of the existing town and the presence of a mountain by west, the town could only expand towards south. Taking into account the topology of the site, the example of Kartal Pendik Masterplan was relevant since it makes use of grid parameterization to suit the project to the surroundings. In Long Hu Qing project, the urban grid that defines the position of streets and buildings is also deformed to respect the natural limits imposed by the river and the mountain area. Besides the natural limitations, the urban plan suited to the presence of the railway line but also respects and promotes the continuity of the already existent roads of the town to expand.

With the last project analyzed, Thames Gateway Masterplan, we could further explore the generation and variation of certain architectural elements, as was the case with this project that uses the main typologies of London. If in the Thames Gateway Masterplan was an association between typologies and parametric geometries, in Beijing the methodology used was similar through the analysis of local Chinese housing and traditional typologies. After drawing the parametric model that formed the basis for the urban typologies proposed in the plan, it would suffer changes and adjustments to its shape depending on the parameters that generated the form: as the dimensions of each part of the urban fabric created, the distances of the different typologies from the river or the limits of the mountain, or even the relationship between the built mass and social attraction. The result ended in the production of a single parametric model which, when exposed to the collected data and factors that define the area of implantation, will be deformed and undergo a series of deformations creating a consistent typology. Even if the architectural elements are all different from one another, they were generated from only a single parametric model. Two buildings will be theoretically equal if the parameters that define them are exactly the same, something highly unlikely given the diversity present in nature and complexity of the urban condition. Once the buildings of the masterplan were generated just from an urban model, it was achieved unity with diversity in the presented project.

The project development for “Food Urbanism in Peri-Urban China - Beijing Re-Farming”, began by analyzing the site to intervene and looking ways to create spaces for agriculture, sufficient to sustain the number of inhabitants which was proposed for the new masterplan. Therefore, it were generated two types of spaces for the practice of agriculture: the first one has implications for the community use
of the population, and the second for private use, enabling food production closer to each typology. The project area lies between the presence of a mountainous area and the river that serves the existing town, characteristics that include the presence of five ridgelines, in this case five rows on the ground where the dimension is smaller. These distinctions of the land came to serve as a motto for the creation of six distinct districts that make up the project. In the division of the districts it was designed the space directed to the collective agriculture practice, and the private agriculture relates directly with the mass of buildings. After defining the ridge lines and similarly to Kartal Pendik Masterplan, it was created a topological grid sensitive to the terrain characteristics. With the modeling of the terrain, the divisions of the districts and the village to expand, it was possible to create the main plots of the masterplan.

With the extraction of information on the proximity of the parcels, as well as natural and urban conditions, a model was generated in order to change accordingly to the needs that we seek to solve. If the parametric model is found near the river, it would take a transversal position in relation to it, in order to promote visual and functional relationships between the river and the urban space. As the distance between the river and a certain plot increases, the model would suffer a transformation. The greater the proximity to the mountainous area, the model started to generate longitudinal typologies so these could fit in the inclination of the terrain.

The control of these parameters allowed the generation of a model where urban typologies undergo changes in order to respond to factors relevant in the proposal. The variation of the parametric model that defines the typologies, from longitudinal to transverse, is also sensitive to the creation of a main urban route that promotes the connection between places like the railway station, the town center or even locals of interest from the riverbank. When the model is close to that path, it evolves to acquire a shape of a cross where activities and interactions are intense through the merge of plots that create empty qualified spaces. These spaces are represented in figure 5 by the yellowish green color, which makes the route as a variable and the creation of voids and masses will respond to the change of the parameters that define them (the example has a demonstrative character, the parameters for the mountain area, the river and the topological grid are not considered).

Regarding the parameters that define the number of floors of each building as well as how they acquire their shape, the upper floors are designed by the same method that was defined the main floor. Thus, the larger the building, the greater the distance between the generated floor and the route referred before. The more floors exist in a typology, consequently, it will be thinner, getting a longitudinal or transverse form, depending on its location in relation to the natural elements. The height of the building is controlled to obtain the lower architectural elements in the vicinity of the marginal and in the urban areas of higher density. Once finished the process of creating all the parameters and relationships between them, it was obtained a masterplan with great flexibility and ability to change.

The parameters that generate the digital model allowed the project to be able to change and adapt in its form, such as the dimensions of each part of the urban fabric created, the distance between the different typologies to the river or the limits of the mountains, or even the relationship between built mass and the places of social attraction.

The final outcome resulted in the production of a single parametric model which, when exposed to the collected data and factors that define the area of implantation, will be deformed and undergo a
series of deformations creating a consistent evolution of the typologies. The control of the parameters made it possible to modify any feature of the plan quickly and easily, where the parametric model was automatically updated. The final design presented is not a simple, static and permanent solution, but an uncountable set of solutions that can be studied and detailed in every moment you find relevant for the long-term in which the city plan is made.

However, another factor must be taken into account to further explore the possibilities of parametrics. The design of urban space, regardless of the season or the methods used, has always been characterized as a complex process and a fairly long period of realization. For the large scale that is discussed and the wide range of components to be considered in urban design, it makes this part of the architect's work one of the most complex and increased difficulties for the profession. This process is always related to a wide range of development stages of the project and the need to respond to numerous questions and issues such as the creation and definition of urban programs, the relevance of networks of roads, development of typologies of buildings for more consistent area development, among many other issues. (Beirao & Duarte, 2010). The complexity in urban plans is sometimes so high that it becomes difficult to efficiently control the desired final solution.

In an analysis of existing urban design methodologies since the eighteenth century, the production process is closely linked to the creation of architectural elements, essentially functional. (Stavric & Marina, 2011). The planning process is associated mostly with functional issues, creating urban space where all the design is strictly enforced by pre-defined and definitive typologies, independent of any particular context outside the project. This overvaluation of functionality on any other aspects was also one of the hallmarks during Modernism of the last century that had a major influence on the realization of the urban planning in that period.

Moreover, the formal aspects that appear to have strong emphasis on parametrisism, should not be subject to projetual overvaluation. The complexity of an urban space is not the exclusive result of the creation of physical elements but the result of continuous urban evolution over time in relation to social, cultural and spatial factors. Urban plans must be proposed in a manner that urban aesthetics are not an imposition and the design decisions must not be only dependent on formal aspects. Such behavior, as explained Danil Nagy (2009), would compromise the success of urban spaces by imposing the extreme opposite occurred in Modernism, and formalism would overlap all the other factors that feature a spatially and socially healthy urbanity. If parametrics, as emerging architectural style, wants to be successful in the design and production of urban space, an appropriate approach is needed in all the issues that contribute to the characterization of an urban space. Currently, most urban plans have developed interventions based on rules in different fields. In a coherent design of urban space, it is necessary to take into account aspects such as laws and rules of allotment and buildings, maximum quotas to respect, rights that pertain to sun exposure, the free appropriation of territories, among other regulations and factors3.

Whenever parametric urbanism uses all actors responsible for structuring a city, avoiding not being only defined by shape but by laws and decisions, the methodology becomes more relevant and coherent.
relative to the act of building and creating the social and cultural factors that shape the urban form. (Nagy, 2009; Stavric & Marina, 2011). That said, the idea of avoiding overvaluation of architectural forms in order to prioritize the most critical and relevant issues in the design of urban space is a must.

4. CONCLUSIONS AND FURTHER WORK

The actual usage of parametric tools is seen by many as a superficial methodology and aesthetically inadequate, since urban planning is not merely dependent on the shape of what is proposed but of urban and social factors (Beirão & Duarte, 2005, pp.493). Nowadays, there is a superficial approach by using parameters in Urbanism that undermines the ideals of parameterization as an emerging style of the past years. Just by giving importance to formal and aesthetic aspects and to the creation of complex geometries, possible through parameterization, there is a lack of relevance beyond most important concepts such as the social and political aspects of an urbanization, where the Parameterization is at risk of having the same failure compared with the modernist movement.

The main reason for its adoption in the digital world focuses on the ability to create a wide range of geometric shapes, from straight lines and platonic solids to highly free and complex forms. The use of parameters to control and manipulate the variations, allows architecture to develop designs comprising single elements without losing unit and cohesion, where manufacturing parts were so economical and easy to produce as well as the freedom to produce the forms, which became easily accessible. The solutions proposed by Zaha Hadid Architects offer an excellent example of parametric approach in the development of urban plans, constituting a group of proposals capable of variation and diversity of solutions, where the final projects relate strongly with the surrounding and other factors such as space and time.

The academic experience in developing a masterplan for Beijing revealed a methodology that offers greater ability to adapt to changes in the urban system. The method allows a variety of possible solutions generated in a simple way and where those can be easily adjusted and modified, making the process much more dynamic and sensitive to several factors. This ability of adequacy of the proposed project and the creation of multiple solutions to the same problem may be the biggest advantages of Parametric Urbanism.

Although parameterization, as architectural style, is still in its initial phase, proves to be already very promising, as indeed revealed in the various examples discussed and the experience gained in the masterplan for Beijing. In continuation of the studies and experiences discussed follows an investigation for a master dissertation that naturally will further develop critical knowledge on this new practice in architecture. It is our ambition that this knowledge, already in office environment, contributes positively in future projects to deepen this methodology in the practical field, assessing the advantages and disadvantages of it. So it is our goal to contribute to the development of a method where the parameterization is one of the main reasons for the creation of solutions in architecture and urbanism.
Ednotes

1 “(...) parametrics in architecture (parametricism) implies the design of buildings not as static objects, but in terms of a series of relationships, controlled by a set of inputs, or parameters. By programming a certain amount of intelligence into the way geometry is generated in the computer, the designer shifts his role from the design of a single object to the design of a system in which many solutions are possible and which is controlled by a defined set of values. This holds many practical benefits for architecture, as an entire design can be regenerated automatically if any design parameter is changed.” (Nagy, 2009, pp.11)

2 “Rather than viewing design as a top-down, linear, and goal-oriented procedure, parametrics can produce structural order and material organization of high complexity, efficiency and beauty, (...) a rule-based approach to design introduces a whole new set of opportunities, which as designers we have the responsibility to further explore and develop.” (Kolatan, 2006)

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5 “Grids, repetitions and symmetries lose their past raison d’être, as infinite variability becomes as feasible as modularity, and as mass-costumization presents alternatives to mass-production.” (Kolarevic, 2000, pp.13)

6 These strange moves which seemed so alien and crazy, once taken seriously within the context of developing an architectural project, turn out to be powerful compositional options when faced with the task of articulating complex programs.” (Schumacher,2004, pp.18)

7 “(...) there is here flexibility without chaos, a morphological system which allows for infinite variation within the bounds of a strong formal coherence and lawfulness. In contrast to exacting and vulnerable Platonic forms, (...) One-North’s form is ‘free’ and therefore malleable at any stage of its development.” (Hadid, 2001).

8 “This calligraphic script creates open conditions – open conditions which can transform from detached buildings to perimeter blocks and ultimately, hybrid systems – together forming a porous, interconnected network of open spaces which ‘meanders’ throughout this new urban centre.” (Hadid, 2006)

9 “As Europe’s largest urban regeneration projects, Hadid and Schumacher believe that Thames Gateway Provides one of the most powerful opportunities to experiment with different forms of urbanism. Rather than applying standard planning tools, they assert that the design of such a mega-development should be approached with an architectural sensibility.” (Whitely, 2007, pp.12).

10 Once the studio was mostly an academic organization, the development of radical and innovative approaches were emphasized at the expense of more conservative and traditional proposals. “By focusing only on form, these projects ignore what most planners already know: that cities are not the products of their buildings or architectural forms, but products of policies and decisions, made by many actors operating in a complex organizational structure encompassing not only professionals but city government and the public as whole.” (Nagy, 2009, pp. 16)

11 “For this reason, any application of parametric tools to planning must begin not from the basis of aesthetics or form, but with the laws and decisions that shape a city, areas in which planners are already acting.” (Nagy, 2009, pp.16)
REFERENCES


FIGURE CREDITS

Figures 1, 2 and 3: Images retrieved in December 2012, from http://www.zaha-hadid.com/masterplans/

Figures 4, 5, 6, 7, 8 and 9: Images held by the author.