SKG IN_FLUX: An Urban ‘Process-Plan’

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Abstract. The paper introduces, analyzes and evaluates the outcomes of a design experiment that took place at the Aristotle University of Thessaloniki in the form of an intensive workshop on parametric urban design. The strategies and methods adopted defined a field for design experimentation as a response to the broader disciplinary discourse related to the use of advanced digital tools, their potentialities in dealing with urban form and their role in architectural education. The workshop’s operative processes and the results obtained serve as a paradigm for an alternative urban design approach. The analysis and the evaluation of this specific approach give rise to further questions and define the goals and anticipations of related future investigations.

Keywords. Urban systems; fields; datascapes; parametric design; dynamic modeling.

Introduction

In a time of rapid technological innovation and momentous socio-economic change, the value of an education understood as the process of teaching a given set of architectural solutions is rapidly diminishing. The new dynamics direct a shift of architectural education towards design research that allows for the systematic build up of innovative work. While committing oneself to the continuous necessity of re-defining architecture both in theoretical and practical terms as the main focus of teaching, the experimental student workshop “SKG IN_FLUX” (explanation 1: SKG is the airport code of Thessaloniki International Airport, used in the title of the workshop as an encoded abbreviation of Thessaloniki, in accordance also with the fact that the site of the design task is located in very close vicinity to the airport.) was a pedagogical initiative of the Architecture School of the Aristotle University of Thessaloniki (A.U.Th.) that aimed to propagate parametric strategies for the articulation of an urban “process-plan” for the city of Thessaloniki.

This nine-day workshop’s experimental agenda had a double dimension seeking to fit into the challenges of complex urban dynamics and new digital techniques. It developed on two parallel levels: the one of creating innovative urban paradigms and vocabularies as an alternative to the deductive logic of conventional masterplanning schemes and the other of implementing innovative methods and techniques of digital design in order to generate such structures. Coinciding with Patrik Schumacher’s lecture on “Parametricism”, that was held in the framework of the parallel activities program of A.U.Th, the workshop initiated students to parametric computational tools and encouraged them to employ such skills in order to animate an alternative
Simulating urban dynamics via digital techniques

In a fast changing world, where massive urbanization is on its way to establishing a definitive, global triumph of the urban condition (Koolhaas and Mao, 1995), architectural education should face the specific challenges that may shape the contemporary city inductively, from the specific to the general. The increased complexity of urban systems is an indisputable reality that directs a shift away from conventional operative strategies and urban planning clichés. Urban systems, within and between contemporary cities, are driven by the dynamics of global economy, politics, climatic change, advanced technologies and increased mobility. Interrelated parameters condition the form and the organization of cities as a result of their metabolism, which is characterized by multiple interactions and processes that interfere in different temporal and spatial dimensions (Weinstock, 2008). These dynamics determine a seemingly anarchic urban condition, which is not necessarily to be regarded as a weakness of the contemporary metropolis. Instead, it poses multiple challenges to investigate the significance, function and potential of new models of urban organization and morphology that are able to negotiate and interpolate between interconnected elements, changing forces and multiple currents of exchange.

At the same time, contemporary architectural and urban experimentations moving towards a new dynamic modeling of urban form, have been exploring the implementation of digital technologies that have profoundly transformed architecture’s practices and techniques. The recent development of advanced computational tools has brought decisive direction to the formation of new urban paradigms. In particular, the use of parametric associative design systems and computational processes has enabled the systematic articulation of complex urban systems, giving rise to innovative projects with inherent design sensibilities and a high degree of sophistication. In such digital investigations, the form and the organization of buildings and cities are being modulated according to correlated parameters, internal rules and contextual conditions. The resulting urban geometries manifest the continuous differentiation and adaptation of new urban fields across multiple vectors of transformation [FIGURE 1].

Figure 1
Student project “Poro(C)ity”: Multiple parameters shape the differentiated urban field.
an avant-garde research agenda, both in terms of spatial and aesthetic effects. Schumacher (2009) remarks “that the shared concepts, computational techniques, formal repertoires and tectonic logics that characterize this work, are crystallizing into a solid new hegemonic paradigm for architecture”, a new architectural style that he calls “Parametricism”. Schumacher explains why the parametric approach is particularly suited to large-scale urbanism. As he suggests, the interaction between parts and the associativity with the environmental performance criteria “lead to the systematic modulation of architectural morphologies which produces powerful urban effects and facilitates field orientation”. The urbanist potential of parametric design has been explored by a global network of architecture schools and design researchers. Verebes (2009), former co-director of the AADRL postgraduate program, remarks that the “parametric approach to urbanism addresses the ways in which associative design systems can control local dynamic information to effect and adjust larger urban life-processes by embedding intelligence into the formation, organization and performance of urban spaces, uses, activities, interfaces, structures and infrastructures.”

**Parametric Urban Strategies**

The student teams were urged to formulate urban strategies that could turn the site-specific forces into fertile ground for project work. This started by questioning the classical notions of hierarchy, centre, boundary and figure/ground relationships. In principle, the teams investigated the potential dissolution of binary distinctions -such as urban/rural, centre/periphery, public/private, interior/exterior, open/closed, building/landscape- and their merging into gradient in-between conditions.

In doing so, the emphasis was shifted from objects to fields, from singularities to open-ended networks, from independent entities to spatial organizations of urban massing, voids and circulatory paths as interconnected elements in flux (Allen, 1997). Thus, it was an attempt to investigate urban space in terms of continuous yet differentiated fields of diverse elements that allow for an almost infinite range of varied and flexible arrangements. In order to proliferate such complex though coherent fields, students had to systematically define a set of parameters and rules, classify the dynamic forces and agents that generate feedback loops of transformations and deal with the theoretical problem of predicting how these urban dynamics unfold over time. Finally, the systematic variation of architectural morphologies was manifested by gradient transformations of the urban geometries and conspicuous directionality of the movement trajectories. This contributed significant urban effects and space navigation qualities.

**Site**

The area of operation is located in the southeastern part of the city’s waterfront, adjacent to Thessaloniki International Airport. It is well connected to the city by multiple motorways and a prospective subway terminal station. A national highway is also connecting the site to the peninsula of Chalkidiki, a major touristic attraction of the greater region of Thessaloniki. The urban plot is a property of the Aristotle University and is currently mainly used as farm lands by the School of Agriculture. The topography of the site is flat and the total area is approximately 200 hectares.

In the neighboring areas there is a highly mixed-use urban development, comprising of luxurious touristic facilities, shopping centers, medical institutions, university buildings, logistic services, small industries, nightlife clubs and other entertainment facilities.

During the design process, the students have been reading the site through the perspective of the activated dynamic field of forces and flows. Field densities, intensities and vectors of transformation have provide the feedback loops that could stimulate change and provoke instabilities, discontinuities...
and collisions as the generators of new urban forms and habitual patterns.

**Program**

The design task investigated the relocation of the Thessaloniki International Fair (TIF) and further research-educational facilities at the Farm Field of AUTh. Comparative advantages of this relocation and potential urban planning arrangements were evaluated as part of a research conducted by the Aristotle University of Thessaloniki, titled Investigation for the possibility of an environmental design on AUTh’s Farm Field for the needs of a new exhibition center, educational and public utilities (Kalogirou, 2009).

Scope of the workshop was the programmatic diversification and intensification of the site. Prospective functions comprised of the following: Thessaloniki International Fair (TIF), conference centers, educational buildings, research centers, office buildings, cultural centers, recreation facilities, touristic facilities, shopping centers, maritime and environmental park, sailing port, sports facilities, and parking lots.

The new urban development called for the proliferation of potential ‘Programmatic Hybrids’ rather than a strict zoning strategy. Thus, it provided for the opportunity to work with flexible types which conditionally mutate from these programs both in terms of space and time.

**Methodology**

Given the short duration of the workshop and the inexperience of students in dealing with parametric design methods and relevant architectural concepts, the teaching strategy was to develop a coherent design process as a goal-orient experimental procedure. Accordingly, the design process involved four distinct interdependent steps:

1. **Dynamic modeling of urban forces and flows.**
   For the purpose of the exercise, students were asked to select three parameters that would prioritize specific environmental conditions of the site, main programmatic requirements and spatial qualities, according to the urban strategy adopted. A set of initial mapping diagrams – dynamic and/or static- were extracted this way, creating multiple datascapes that would subsequently become design input for the articulation of the urban field [FIGURE 2]. In a more

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**Figure 2**
Student project “U.S.E.”: Dynamic mapping of attraction and repulsion relationships of programmatic elements.
realistic scenario, parameters in play are far more complex, numerous and often times contradictory. Nevertheless, in order to maintain a level of complexity that would be appropriate for the exercise, students abstracted the design process according to prioritized design requirements and strategies.

2. **Development of an urban massing component with inherent geometric associations according to internal organization rules and parameters.**

Complex systems are characterized by hierarchical relationships between components and elements that synergetically give rise to biologically inspired architectures. This step of the exercise focused on the associativity and interdependency of local and global scale. Students had to come up with complex configurations, constructed as a parametric model with extremely sensitive figuration variables [FIGURE 3]. Ideally, these geometric configurations would be constituted out of multiple subsystems so as the architectural morphology, tectonic articulation and interior organization would be parametrically malleable as a continuous urban system.

3. **Versioning and differentiation of the initial component. Mutation of types and evolution of multiple ‘programmatic hybrids’.**

There is a direct analogy to natural systems’ differentiation for specialization; within one organism some cells specialize to do a specific function, for example to introduce air in the structure. Thus local differentiation responding to performative requirements leads to an overall optimization. Multiple environmental inputs drive the differentiation of components along the structure, increasing the performance of the urban configuration. Formal differentiation of the component developed by the students generated a population of gradient forms that are topologically equal, yet morphologically differentiated and thus responding differently to diverse performance criteria. In this stage students were encouraged to investigate the correlation between performance and its organizational and formal manifestation.

4. **Adaptation of the differentiated types to multiple datascapes and systematic articulation of a complex urban field of interconnected elements.**

Having understood the repercussion of the form to the performative capacity of a component in
local scale, this step was seeking for an emergent global form that would respond to environmental requirements by creating links between the dynamic maps generated in step 1 and the differentiated component proliferation across the site, creating urban massing, circulation paths, urban voids [FIGURE 4]. The exercise was coupled by introducing students to the general theoretical discourse on current architectural research which focuses on the performance, adaptability and intelligence of the built environment. “New technologies have accelerated the shift from a Modernist preference for homogenous space to a contemporary preference for heterogeneous space” (Hensel et al. 2009). This step involved the translation from site data to form, which was not always a very straightforward process; it involved in a great extend the designer’s preferences with regards to the rules that would condition such translation, based on both performative and aesthetic criteria.

**Techniques**

Advanced digital design tools have become accessible to architects and are converted in agents that are accelerating changes in the praxis of architecture. Branko Kolarevic affirms that “digitally driven design processes, characterized by open-ended and unpredictable but consistent transformation of 3D structures are giving rise to new architectural possibilities” (Kolarevic 2003). Parametric associative models have the capacity of processing an amazing amount of data creating links between the geometry and its expected behavior within an environment. Within a parametric design platform, external input (numerical data, reference points) can directly inform the geometric configuration, thus environmental data or material constraints can be used as architectural input regulating the orientation, scale, alignment of architectural objects.

In order to animate and actualize the prospective ‘process-plans’ and to ultimately come up with articulate urban fields, the workshop employed parametric associative design tools and scripting techniques. Intensive tutorials were given on ‘Autodesk MAYA’ and other computational programs in order to help students master such computational skills. Emphasis was given to specific dynamic modeling tools which were used to generate coherent urban fields and systematic versioning and adaptation of their interconnected elements. Programming in MEL was employed to create the necessary links between components and dynamic mappings so that the students could experiment and dynamically create adaptive urban configurations.
Evaluation and future steps

The design processes described here aimed to explore a relatively new field of architectural experimentation related to the dynamic mapping, simulation and design of urban systems through advanced parametric tools. The combination of computational techniques and design methodologies in a continuous integrated system led to a design approach where geometric characteristics, spatial qualities and environmental performance iteratively informed architectural form generation. Data exchange played a critical role in enabling a multi-way flow of information among different entities, scales and routines.

The workshop was a short term experimental approach for an alternative design of complex dynamic urban systems and a valuable pedagogic exercise for students in order to explore new techniques, concepts and strategies. It is worth mentioning that the great majority of students involved in this design experiment had little or no prior experience with dynamic modeling, parametric tools or programming, thus a big part of the workshop’s goal was to familiarize students with a genuinely new for them design approach. This brought certain limitations both in terms of time management, as well as in teaching strategies and decisions related with the design process.

The complexity of such a task, linked on one hand with the mastery of computational tools and on the other hand with the critical engagement with upcoming design problems and the real urban development requirements, would demand a further elaboration of the methodologies and techniques described above and a more critical investigation of such a research agenda by the students. A year-long design studio could constitute a future educational framework that through experimentation, critique, confrontation, exchange, argumentation and debate, would allow for an in-depth exploration of such a research agenda as a more mature phase of digital experimentation with urban form. In this case, the experimentation would aim at a further development of the ways the contents and forms of expression of the parametric approach to urban design are converted into teaching practices and educational outcomes. The real challenge of an innovative educational approach would be to come up with considerably new spatial constructs that effectively parameterize urban processes rather than architectural geometries.

Acknowledgements

The Workshop “SKG in flux” was organized by the Aristotle University of Thessaloniki in December 2009.

Coordinators: Kalogirou, N Papakostas, G Tzaka, A

Guest Critics: Schumacher, P Zettl, R


Teaching assistants: Chatzitsakyris, P Giokalas, G Gourdoukis, D Pantazi, M Symeonidou, I Trifonidou, K Vasilakis, F

References


Kalogirou, N Paka, A Tellios, A Tzaka, A 2009, ‘Investigation for the possibility of an environmental design on AUTH’s Farm Field for the needs of a new exhibition center, educational and public utilities’, Scientific Annals of the Faculty of Engineering, A.U.Th., Thessaloniki. (Under publishing)


Koolhaas, R and Mao, B 1995, ‘Whatever happened to ur-
banism', S,M,L,XL, Monacelli Press, New York, p. 961
global style for architecture and urban de-
sign,’ in Leach N. (Ed.), AD Digital Cities,
Verebes, T 2009, Experiments in associative urban-
Weinstock, M 2008, ‘Metabolism and Morphology’, in
Hensel M and Menges A (Eds.), AD Versatility and
26-33.