URBAN TECHNIQUE - **postgraduate programme - university of applied arts, vienna**

morphogenetic transitions (workshop robert r. neumayr)

introduction: morphogenetic transitions - from space to field

the conceptual challenges of contemporary urbanism are essentially twofold: for one the research-based, meaningful distribution of urban massing across an increasingly complex urban field, and secondly the typological development of flexible and malleable geometric entities and their subsequent systematic transformation according to the changing internal and external parameters that guide their use.

so far architecture and urban design have mostly been relying on vernacular local patterns or on formal resources dating back to ancient greece. the classical architecture privileges simple, clear and distinct platonic figures like squares, triangles and circles, symmetries and simple proportions. spatial compositions are always arranged in strictly hierarchical formal systems, following a deterministic design process.
It appears though as if these traditional design strategies are no longer able to reflect the increasing complexity of today's networked society.

urban structures are increasingly understood as complexly networked field organisations, which are organized primarily around currents and lines of exchange where people, services, ideas and goods are collected, organised and redistributed in a multitude of directions (for an account of these phenomena see: de landa, 2000).

rather than seeing a city as a number of independent entities, we have now come to understand the city as a continuous field of diverse yet interconnected elements, as a spatial organisation that is able to negotiate and interpolate between those elements, which are subjected to the changing forces and currents that guide their use.

as stan allen remarks, "*field conditions move from the one toward the many, from individuals to collectives, from objects to fields.*" (allen, 1999).

urbanism as we understand it is always driven by a multitude of different influences that act simultaneously. these influences are of totally different nature and not all of them are necessarily architectural or urbanistic. our cities are shaped by straightforward parameters like topography, orientation, climate, or infrastructure, but also by more abstract constraints like politics, sociology, economy, building industry, ecology, or power.

also more abstract, conceptual, tool-based or mathematical and geometrical design strategies can form the initial set of parametric layers, that start to drive an urban project. yet again, as a designer, one sees herself confronted with a multitude of different dynamic influences that need to be negotiated simultaneously and brought into balance with a set of specifically straight forward architectural and urbanistic constraints.

these dynamics can be analysed and described using models from various other scientific disciplines.

the concepts and logics currently being appropriated for urbanism are mostly drawn from the domains of mathematics, physics or biology and include *fractal systems (*e.g. l-systems, mandelbrot systems), *dynamic systems (*e.g. fluid dynamics, particle systems), *crystalisation systems (*e.g. diffusion limited aggregation), *self-optimising systems (*e.g. voronoi patterns, foams and bubbles), *geometric systems (*e.g. triangulations, self-similar subdivisions), *behavioural systems (*e.g. flocking, swarming), *cellular automata (*e.g. game of life), or *network theories (*e.g. frei otto's path optimisations or hillier's work on urban networks).

all these systems are to a certain extend characterised by the following properties:

modulated field conditions: a system is able to create a modulated field of different yet gradually changing densities and/or other properties that are held in a dynamic equilibrium. emerging and receding patterns (of geometry) resulting from this system are always understood as modulations of an in itself continuous system of changing dependencies, where each modulation becomes an environmental condition (i.e. an agent of change) to their adjacent entities.

complexity: the system builds up complexity out of a series of single components. however, their interaction according to a set of simple rules and their initial condition give rise to a high level of complexity.

emergence: the emergent properties of a system are generated by the recurring iteration and superimposition of interactions of its single components, which add up to the complex state of that system. consequently, the result of such a non-linear process can – due to its complexity - not be predicted. this is also known as a “bottom-up” process, as opposed to a “top-down” process, in which the overall form is determined first.

gradient transitions: a field is seen as one continuous organisational unit, which organises and modulates a series of entities, that are subjected to the same set of internal and external rules. as the parameters that drive these sets of rules vary gradually across the field, no binary conditions occur, rather gradient transitions from one state to another.

by taking these processes from their initial context into the domain of urbanism and architecture, urban planning starts to shift towards a new paradigm, whose outcome can later on be compared to the results of conventional urban strategies and the results of the analyses conducted on different parts of the city.
however, one needs to observe that the strategies, which one begins to extract from other fields of science, initially have no architectural value per se, as they operate in other scientific domains. their logics need to be analysed, abstracted and appropriated to suit urban and architectural purposes. they can not generate architecture or urbanism but merely serve as a dynamic, changeable, informed pattern of distribution (an abstract machine), establishing different sets of rules that guide the differentiation and proliferation of urban patterns (and volumes and geometries), which in turn are based on the topologies that emerge from the contextualized parametric processes.

these processes need to be taken beyond the straight-forward application of scientific tools to urbanism or architecture, as the mere control of techniques does not necessarily result in successful architecture or urbanism. research needs to result in the development of a series of different architectural and urban layers that operate within the logics of the techniques applied, yet move past the mere transcription of (semi)scientific algorithms.

an architectural layer then needs to be added onto and connected with the system in order to transform this diagram to valid architecture. this layer will vary according to the designer's capacities and must be understood as an integral part of the overall design process.

the appropriation of complex recurring geometric patterns and their underlying mathematical concepts as well as the understanding of emergent, fractal, chaotic or self-optimising systems and their bottom-up logics of development and proliferation will become a source for the experimental development of gradient urban field patterns with different degrees of densities that are able to generate and host a whole variety of new complex urban geometries.

design methodology and scope of work

based on the forms developed so far and their initial, abstract distribution logic, students will start to contextualize their geometries by placing them in their specific urban context and subject them to a series of iterative differentiation processes. Students keep on working on the sites, they have already chosen for their thesis project.

while the first iteration will necessarily result in a collage-like set-up, the task is to generate an increasingly complex urban field condition with a high degree of emergent (i.e. unpredictable) complexity through an intricate and intrinsic system of order. the main challenge is to machine complexity, which in its final state can still be understood and recognised based on its initial laws of generation.

to this end students try to understand, describe and quantify the relational qualities of their multitude of objects in relation to their respective position within the urban field and in relation to their neighbouring objects. The criteria that have previously been established by each student for the generation of the geometric prototypes and their abstract distribution in space are further investigated and form the starting point for an extensive list of relational criteria that describe the objects and their position in space. Using the digital tools at hand (i.e. grasshopper) these criteria become the driving forces for a parametric digital set-up that allows to configure a series of urban field conditions that reflect the emergent interaction of the concept's multiple criteria and can subsequently be evaluated accordingly.

in addition to each student's individual thesis design agenda and its specific conceptual rules and regulations, attention should be given to the following – more general – urban field conditions, that all could act as an additional layer of differentiation:

global field conditions:
what are the global logics, that drive the urban field you are generating? which contextual layers can be identified and used to differentiate the field on a global scale **(i.e. the relation of the object in respect to its position in the field)**? global field conditions might be: topography, circulation patterns, environmental conditions, orientation, site distribution and subdivision, program location logics, navigational logics, infrastructural connections, or relations to neighbouring city conditions.

local (object-based) field conditions:
what are the local or internal logics, that cohere and differentiate the urban field you are creating **(i.e. the relation of the object in respect to its neighbouring objects)**? Local field conditions might be: programme distribution logics, typological considerations, relational quantities like the relation between the height of two buildings and their distance or the issue of view and visibility, internal site subdivision, clustering and grouping, local neighbouring conditions like noise, the installation of orientational or navigational logics, or semiological considerations.

boundary conditions:
what defines the edge conditions of the scheme? Does it extend to the site's boundaries, is there an inner logic that limits the extents of the field within the site or does it exceed the site limits? What are the site's different edge conditions? Are the existing neighbouring city fabrics that need to inform your scheme at the edges in terms of city grids, patterns, densities, height, etc. or topology in order to prevent collage-like conditions?

the volumes of the differentiated urban field will be read as a swarm formation of many buildings. according to the changing density within the generated urban field these buildings form continuously varying formations with different density figurations, whereby as a consequence:

every plot of land holds the possibility to have a building, BUT not every plot has to have one.
no two buildings are exactly the same.
there are lawful continuities that cohere this multiplicity of buildings.

within this emerging formation buildings can be read as a series of differentiated pheno-types, based on the same geno-type (= typology), which performs within a well balanced range of difference and repetition (if an urban field is too homogeneous it becomes boring and repetitious, if it is too heterogeneous it becomes confusing).

the resulting mass distribution, the relation of its volumes and voids and the differentiated urban geometries, can then be analysed in terms of their actual performance, comparing them to the performance criteria set up in the theses' design strategy.

based on the results of this evaluation, a possible next step could be to start an iterative process in order to optimize the preliminary design results, by either re-evaluating the different parameters that influence the outcome of the process or by fine-tuning the process itself.

suggested readings:

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