The Depth of Surface

Since the early 1990’s the notion of surface has evolved into a formal trait among the avant-garde architectural discourses. Conceptualized within the Deleuzian ontology of ‘the fold’ it has become associated with diagrammatic techniques and digital morphogenesis, prolifically materializing in the projected and the built by continuity, curvature, smooth layering and manipulations of the ground1. Liberating architects from typology and the order of the box, the focus on surface processes diversifies architectural research in exploring and making explicit form defining strategies that envision a redefinition of architectural performance. As a diagrammatic practice that appeals to morphogeneticists as well as urban conceptualists, the surface has acquired conceptual, operational and material depth.

In the semantic network of present progressive architectural language surface manifests high conceptual connectivity. Browsing through ‘the dictionary of advanced architecture’2 reveals ubiquitous presence of the term, making explicit the establishment of a design world constituted by notions of surface, folding and unfolding, topology, land strategy, dynamic trajectories, flexibility, obliquity, systems, devices, paradoxes, origami, bends and unbendings, braids, coiling, and contortionisms. These notions are operational; their definition is supported by diagrams and architectural models. In a future revised edition of ‘the dictionary’ -as almost a decade has past since its publication- we could anticipate architectural photography of iconic projects too. More recently, Michael Merendith in the chart of ‘Medium Specificity in Architecture’ presents the ‘surface’ as one of the dominant architectural media together with ‘field’ and ‘diagram’- of the nineties. Defining surface architecture ‘as a topological construct where the envelope, curvature and figuration are the primary modes of architectural expression’3 Merendith historically relates the ‘surface’ to -presumably by opposition- typology and the grid, and draws its conceptual links into the digital discourse through the blob/NURB, the parametric, the ornament, and the biological.
Having completed a decade of being state of the art and having materialized in a sufficient number of influential buildings, ‘the single surface’ may no more constitute an architectural challenge and may (by some) be considered as an architectural trend passé. Despite the fact the discourse around surface still generates a theoretical reservoir to digital morphogenesis, granting a certain symbolic capital to processes that would otherwise appear as purely technical and devoid of content. Morphogenetic research on single surface transformations holds the capacity to mediate between analogue and digital allowing materiality to couple spatial reorganization. As a design methodology it establishes a dynamic equilibrium between processes and products, it enhances topological thinking and enables integrity between envelope and ornament. In the next chapters of this paper I shall demonstrate the potential of surface as an operational and generative concept in architectural design education, elaborating on the ‘supersurfaces’ studio research agenda and recent developments. Methods, range of experimentations and in depth elaboration of one case study will structure the argument supporting the rationale.

‘Supersurfaces’ Academic Research Agenda

‘Supersurfaces’ comprise experimental morphogenetic research that focuses on physical modelling of single surface transformations. In the elective studio that I have taught at the Department of Architecture, University of Thessaly for the past years, the challenge lies at the production of physical dynamic models that bear the potential to produce certain topological and morphological automata. Investigations focus on material form finding processes consciously attending to literal transcripts of the practice of paper folding. A state of the art definition of what we do in the studio can be described with Patrick Schumacher’s notion of ‘material computing’. A term Schumacher uses to describe ‘analogue form-finding processes that can complement the new digital design tools and that might in fact be described as quasi-physical form-finding processes’. However, I believe that physical form finding retains its autonomy-primarily due to the resistance of the material- as well as certain educational advantages to digital morphogenesis. The primary benefit of researching single surface transformations by physical modelling relies on the activation of topological and computational thinking by means of hand and mind coordination. The intelligence of the hand is the mediator between topology and material. Experimentation along the ‘supersurfaces’ method-continuous transformations of material single surfaces - not only complements digital form finding but also generates challenges,

Figure 1: Meanderplex paradigm. © Author.

Figure 2: Meanderplex object series. © Author.

Figure 3: Meanderplex participatory form finding event. © Author.

Figure 4: meanderplex installation at The Archive. © Author.

Figure 5: Meanderplex object to pattern cycle. © Anjia Zahariadou & Constantine Stergiopoulos under the guidance of the author.
unprecedented complex forms with a physical substance that yet remain to be modelled in silicon.

As a matter of fact the ‘paperfold’ is a neologism; a synthetic word introduced by the author to describe the outcome of a paper folding session. Throughout the development of ‘supersurfaces’ academic studio research over time ‘paperfolds’ have been initially investigated as physical artefacts, and as material diagrams. Investigations focused on how they are made, how they could be modelled, what are their intrinsic properties and how they could be productive in order to fulfil an architectural program such as a programmatic hybrid, or a land strategy- or more recently a bottom up- or in medias res- generated design task. The studio curriculum outlines a sequence of tasks: intuitive paper folding, mathematical descriptions of paper folds through basic level generative algorithms, surface unfolds, object series. The sequence of tasks allows iterations and feedback loops promoting the production of object populations rather than the selection of the fittest one. Materiality studies are introduced when an object series has been defined through basic level algorithms and flat state pattern variations. Suggesting explorations into alternate sheet materials and shifting from paper to foam, rubber, p.v.c., polypropylene, polyethylene, re-enforced fabrics, gypsum band, mesh, leather, copper, aluminium or plywood. Material studies produce diverse options for prototype development and proceed through scale investigations and possibilities to inscribe prototypes within everyday practices. The range of results includes unprecedented, kinetic, multitasking and sustainable object and space prototypes gaining applicability in a fusion design field between architecture, product and fashion design.

During the past five years research has accumulated into an archive of ‘paperfold’ prototypes or primitives including self-intersecting strips, meander varieties, spline curved creases, origami originating fishbones and other deployable patterns that students can reuse and elaborate into prototype development and large scale installations. More recently ‘paperfolds’ have been investigated as processes of surface treatment related to the ancient craft of textiles focusing on techniques of pleating, cutting, stretching, weaving and tilling. The methodological stance adopted in this later phase builds upon the notion of a morphogenetic narrative rather than a morphogenetic design strategy, focusing on collective processes and event parameters within the educational context rather than the elaboration of specific design assignments. ‘Paperfolds’, besides their design generative capacity as material diagrams are also considered and exercised as opportunities to scaffold a temporary community within the studio. Group cohesion is stimulated by establishing

a creative commons aspiring to the production of fragments of an architectural Gesamtkunstwerk. The narrative accentuates morphogenesis as a process, framing the evolution of forms in time, sifting focus from the object as a complete product to the object as a sequence of events. Liberating form generation from a design objective establishes a relative autonomy of the creative process, creates a ludic domain, where a free play between form and material, envelope and pattern, scale and usage takes place through oscillations, transcriptions and reiterations.

Meanderplex

I shall illustrate recent developments in the research agenda adopting the morphogenetic narrative approach with an experimental project partly organized within studio ‘supersurfaces’ on academic year 2009-2010. Primarily based on a model of workshop teaching, the project developed around three main cycles: individual form generation within one family of objects, participation in a collective large scale installation, and further individual prototype development drawing from the collective product. The gap between individual and collective student development and group cohesion was bridged by educational devices that enhanced the notion of a creative community. Research in the studio revolved around a reservoir of ideas and prototypes that students share by depositing into and loaning from. Students were prompted to appropriate and expand upon a given prototype, a ‘paperfold’ primitive from the studio archive. Further they were asked to participate in the creation of object series, of endless parallax, leading to the production of a collective installation. Finally by selecting fragments of the collective product they had to begin a cycle of individual prototype development.

The academic studio experiment as a multilayered research project is titled ‘meanderplex’. Literally meaning the weaving of the meander, ‘meanderplex’ as a metaphor evokes the act of weaving a temporary community through the culture of making: by participation in the production of a collective product. In more conventional morphogenetic jargon ‘meanderplex’ [Fig. 1] could be described as a parametric form study in analogue media. Form generation develops ground up. There is an apparently endless parallax of objects deriving from one meander strip by employing simple rules of enfolding and self-intersecting. This is described through directed pairs of edges and slots, in disciplined or random sequences. Within each object curvilinearity is a physical automaton, a product of the ruse-based analogue machine. The overall form, a mega cluster of interweaved
objects, could be considered a retro futuristic application of the primordial textile technique of weaving. Individual object formation and assemblage abide to the same rules of the meander strip.

The first part of studio consisted of introductory concepts and tools specific to single surface transformations through lectures, intuitive paper folding sessions, visual narratives and basic level form generation algorithms. Teaching components were four hour studio sessions once a week, demanding intensive work in class. In the second part of the studio- duration of 8 weeks- the ‘meanderplex’ project was developed in the following steps:

a. Paradigm
b. Object series
c. Participatory form finding
d. Documentation
e. Façade Installation
f. Post Production: Object to Pattern and Pattern to Object cycle

a. Paradigm

The unfold or flat state pattern- of the meander is submitted by the author as a prototype or primitive supersurface. This is delivered as an instructive plan, where incisions are drawn, slots and edges tagged. Joining edges with slots produces one three-dimensional curvilinear single surface [Fig. 1]. Joints are perforations of edges through slots, in other words, self intersection of the strip. The sequence of directed pairs of slots and edges are coded as a basic level algorithm. One example selected by the author for its capacity to generate multiple variations- is submitted as one instance of a parallax series illustrating the process of form generation.

b. Object series

Each participant is provided with one sheet of carton 100x70cm. The task is to produce nine variations of the meander prototype noting for each one the form generation algorithm. Participants are introduced to the notions of endless parallax and object series. A population of objects derives from the paradigm [Fig. 2]. Comments on notation discrepancies feed back into the notation system. Objects are evaluated in terms of connectivity, compactness and holding potential, their capacity to become modules of a cluster. This phase encompasses individual study. Group cohesion is maintained within the family of objects produced.
c. Participatory form finding

Participants create a collective object log, the archive of objects produced including a form defining algorithm and one photograph of each object. Participants are asked to reproduce some of their most successful objects as potential modules. Selecting modules from the collective object log, each participant remakes and contributes nine objects to the collective construct. Intuitive clusters of modules are formed by interweaving free slots and edges. A provisional suspension system is constructed. Participants are asked to weave clusters together by adjoining free slots and edges, maintaining interlinking and counter balancing. Assembly in suspension proceeds according to these rules until all units are utilized. ‘Meanderplex’ mega cluster is produced as a meandering self-intersecting strip endlessly interweaving in endless parallax [Fig. 3].

d. Documentation

The documentation of the event, parallax object generation and assembly process were edited into a slideshow. The slideshow was distributed to all participants. The slideshow is available online and can be accessed at www.supersurfaces-supersurfaces.blogspot.com

e. Façade installation

The ‘meanderplex’ workshop was instigated by an invitation to exhibit ‘supersurfaces’ research development in the context of ‘The Archive_ Episodes’. In this prospect the author designed an installation that would demonstrate research processes and physical results responding to the particular spatial qualities of ‘The Archive’ venue. The ‘meanderplex’ mega cluster was placed on the facade, while the visual narrative of its production as a collective work was projected inside. In fact the collective assembly artefact created in the studio was dissembled. The final exhibit which was remade in my atelier consisted of a finite number of modules interweaved to best visual and sculptural impact. ‘Meanderplex’ here is represented both as a general and generative process and as a product; a soft, porous paper structure suspended and illuminated providing visual filtering and environmental ornament [Fig. 4].

f. Post production: Object to Pattern and Pattern to Object

Following the exhibition installation students were asked to generate a 2D pattern, deriving from the objects produced. Each individual or group was able to select modules from the
collective object log and construct a regular cluster through repetition of one module. The new assembly object was further treated as a 2D pattern generator. A fragment of an image of the object was treated by plane transformations - symmetries, linear and polar arrays resulted to surface patterning [Fig. 5]. The 2D pattern was further projected upon a digital surface and re-entered a cycle of continuous transformations. New surface objects were designed and manufactured incorporating the laser cutter fabrication utility of the Department. This last assignment introduced a certain depth to the patterned surface through relief. Some students opted for a pure digital morphogenetic process remaking the selected meanderplex unit in silico while others oscillated between analogue and digital media.

In conclusion

The outcome of the meanderplex project in terms of knowledge was the comprehension of characteristics of topological surfaces and their form generating potential, as well as some basic concepts of parametric design such as variability and articulation of form defining factors and their relations via sets of simple rules. While that would be the accomplishment of one strictly defined design knowledge task, a complimentary benefit was the immersion of the students in the process of the collective construction of an architectural object, in scale 1/1. The workshop enhanced the students’ ability to work individually towards a collective product. Partaking of a complete production process from concept to exhibition as well as the development of the installation was a rewarding and satisfactory experience. A small scale ‘design-build’ endeavour characterized by participatory form finding. Drawing from a collective pool of prototypes to produce an individual study and later feed back into it supported the formation of a temporary community around a common creative ground.

The ‘Meanderplex’ project is explicitly represented in terms of process; its value relies both in its paradigm as process orchestration and as a physical product of the process. I believe that such a constitution would very well fit the profile of the current architectural object, as a product that gains its added value through its self-explanatory capacity. Its capacity to weave a narrative of origination and development processes as well the ones it can potentially partake in. And further we may be discussing an open product and an open process of participation the potential of design processes as events leading to the formation of a temporary community around the culture of making. Therefore I would like to argue that the methodological
and educational benefits of a morphogenetic narrative as in the example of recent developments in 'supersurfaces' research rely on redefining authorship from the invention of an object to the orchestration of a collective and participatory process. Creative form generation engages the composition of a plot, of a script for a design procedure. Kostas Terzidis had described a ‘replacement operation’ between human intelligence and computer program within the evolution of digital design envisioning ‘that realm where the new designer constructs the tool that will enable one to design’ in an indirect ‘meta design fashion’. The method presented in ‘supersurfaces’ could be considered as a material and conceptual propedia to automated design. Enabling and empowering students to exercise computational thinking without necessarily computers while persisting on the how and why create forms.