

L'ARCA

La rivista internazionale di architettura, design e comunicazione visiva | The international magazine of architecture, design and visual communication

ACI Logo Competition

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Eco_logical design is the outcome of interdisciplinary research into a new form of sustainable architecture from both an energy and social viewpoint. The aim of this research is to develop a design process capable of exploring the (non-linear) cause-effect relation between form (geometry/structure/materiality) of an architectural shell and its (environmental/ergonomic) performance ratings in relation to the user's spatial requirements. This means it is not just an exercise in style aimed at reproducing organic forms.

The theoretical background to this research project is based on an analytical study of the generative-evolutionary processes of form that take place in nature. More specifically, attention focused on the ability of animate and non-animate beings to "organise themselves" and adapt symbiotically in space and time to certain contexts. The distributional logic resulting in changes in a chameleon's skin, the system for opening up and arranging the petals of a flower etc.. are taken as examples to be referred to for the way they co-ordinate systems. Well aware of the fact that architectural forms are inert: they neither create nor die. Despite the great temptation provided by digital animation, architecture remains, paraphrasing Goethe, "frozen motion".

After all not even Bergson claimed that architecture could be absorbed into the perpetual becoming of life. On the contrary, the philosopher emphasised a fundamental difference between the "organisation" of nature and the "manufacturing" of men. The latter "involves giving shape to matter, making it ductile and moulding it into a tool under human control"; it involves "assembling bits of material... in order to make them serve some common purpose". Taking this as a theoretical premise to the design process, the designer's role consists in developing a work of architecture derived from a process of material organisation.

This means Eco_logical design actually has nothing to do with the conventional idea of "green" architecture. The ecological aspect of this morphogenetic process is represented by its systematic ("organisation") and evolutionary approach to the generation of form and its propensity to spread. The plan is to satisfy the urgent call for sustainable architecture by coming up with the kind of work methods associated with bottom up systems, calling into question fundamental concepts of design. The suggested approach involves selecting a range of formal configurations (species) obtained by a parametric variation on a simple unit (genotype), the configuration best suiting "site specific" contextual features (environmental, social etc.). In this case, then, the dynamic interaction that the model sets up with the context does not depend on robotics (kinetic response) but on the designer's skill at generating the initial model (system of relations), selecting the "freeze", and then implementing/contextualising the selected model. In which case it is clear that the idea of typology is replaced by topology (the science studying the invariant properties of forms).

The topology in this approach is an important, sophisticated yet basic tool for establishing the laws governing the composition of a structure and the ways in which it can be deformed. Transferring theories like topology and emergence into the realm of architecture is experimented with by making integrated use of parametric (physical/digital) modelling techniques and environmental simulation software programmes. This means the project turns into a formal transposition of an intricate ecology of intents, the result of engineering an operating system rather than implementing a pre-determined solution. Hence the tendency to generate material organisation capable of responding dynamically to the complexity of the surrounding environment.

The strategy in question tends to bring into act a sort of disciplinary pre-architecture, a system of rules and relations represented

by what Gilles Deleuze describes as an "abstract diagram". The operating principles governing this initial diagram are determined by the choice of a spatial/geometric/structural organisation designed to capture specific information emerging from an analysis of context. During this phase, the variables of a specific context are considered in their quantitative (and hence not arbitrary) aspects, so as to provide data capable of informing the initial diagram (genotype). To do this the analytical study of environmental dynamics (micro-climate, topography, flows of people and things etc.) takes the form of experimentation with diagrammatic and mapping techniques. These techniques are often backed up by the use of software processing programmes and they visualise the data in correlated form. The result of this stage is a configuration of which in biology is known as a genotype, and also the processing of data guiding it through its physical manifestation (phenotype).

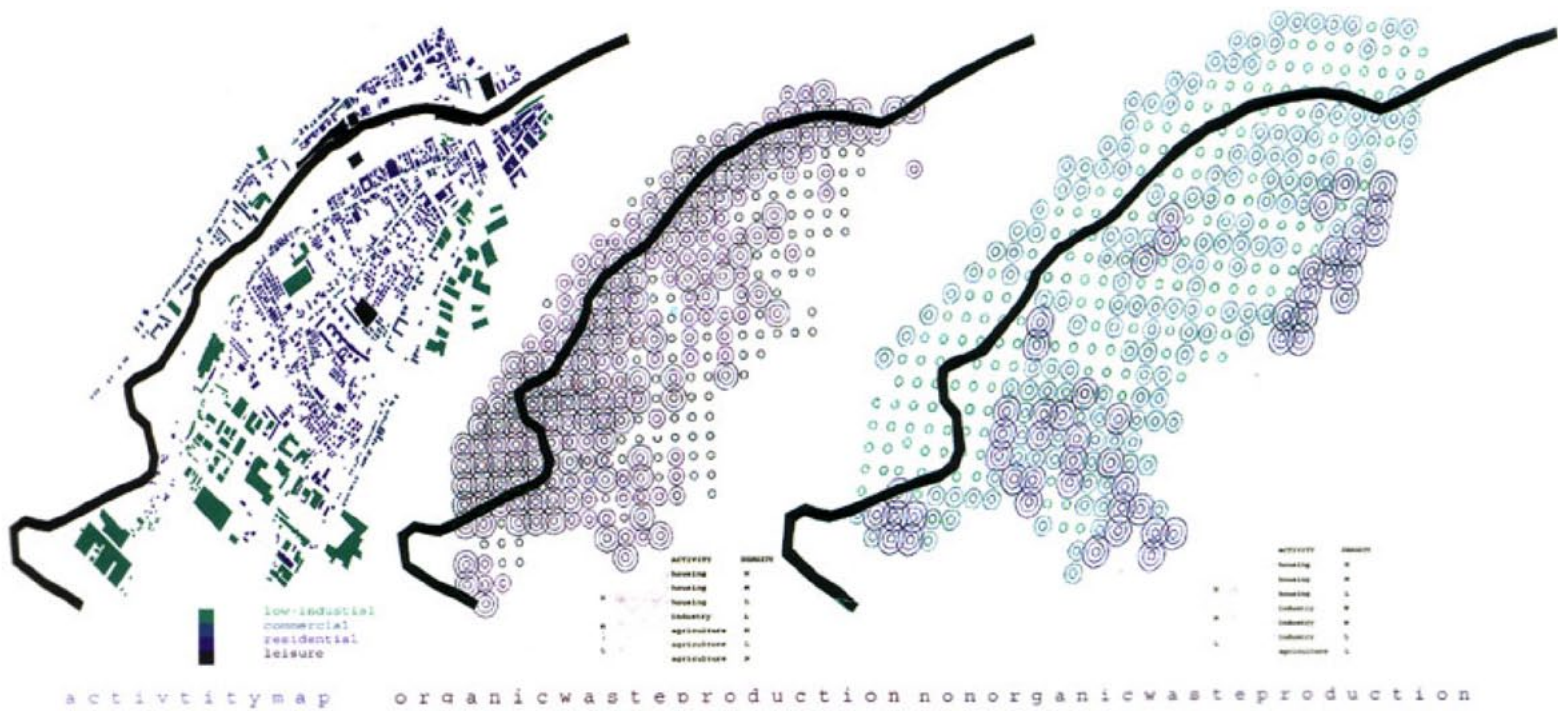
Form finding, introduced on an experimental basis first by Buckminster Fuller and then Frei Otto, is a design method exploring matter's tendency to organise itself in relation to the action of certain outside influences. It is used in architectural design to generate efficient structural forms. The shell structure and form are intrinsically interconnected in this eco_logical approach. The "form" of the initial genotype (abstract diagram) is worked out from the interrelation between the application of architectural actions (fold, twist, perforate etc.) and sets of parameters (environment, construction principles, materials etc.), whose "actions" are expected to respond.

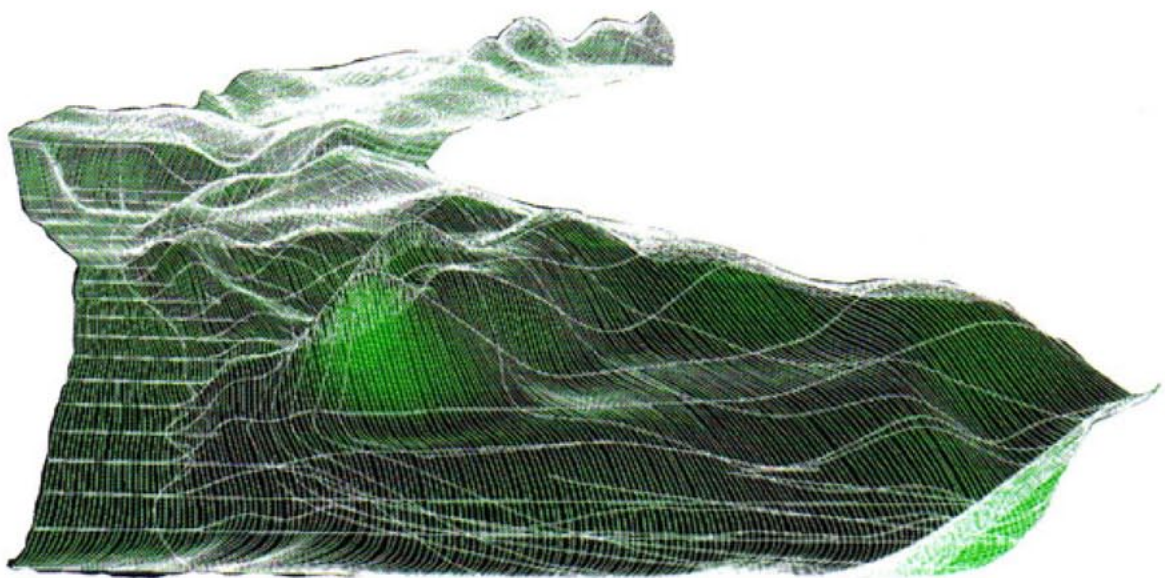
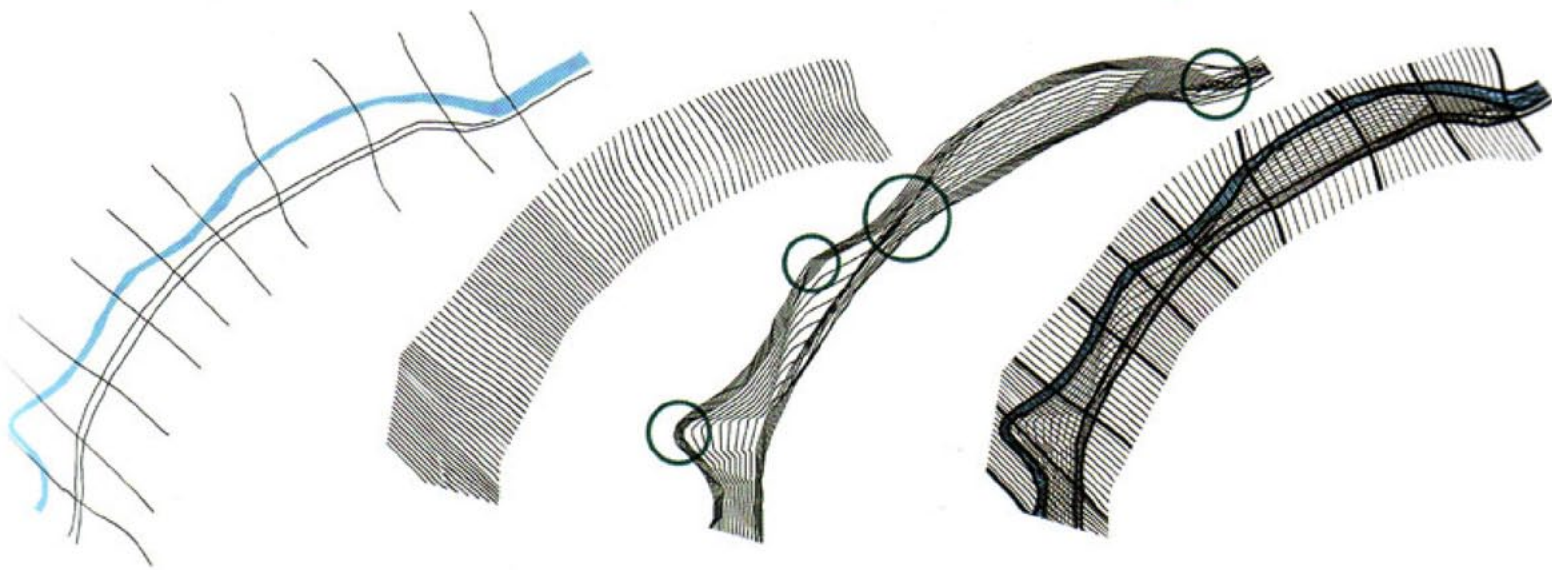
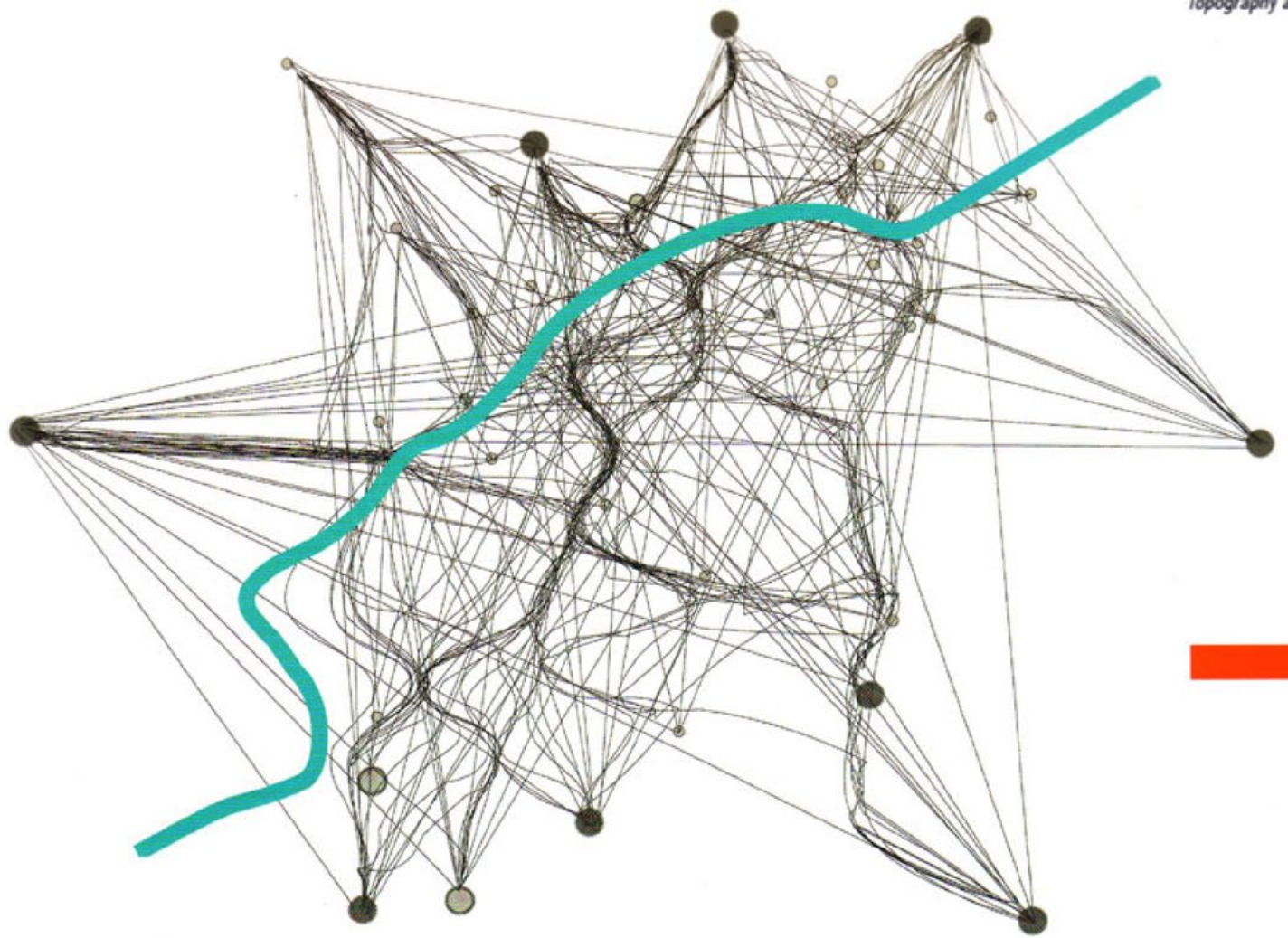
Thanks to a combination of parametric (physical/digital) modelling techniques and rapid prototyping techniques, eco_logical design works on multi-parametric experiments. This means all the multiple forces (construction processes, materials, environment) acting on the system are taken into consideration at the same time. The final result of this design phase is the creation of a catalogue of possible stylistic/structural configurations, whose performance ratings are analytically assessed.

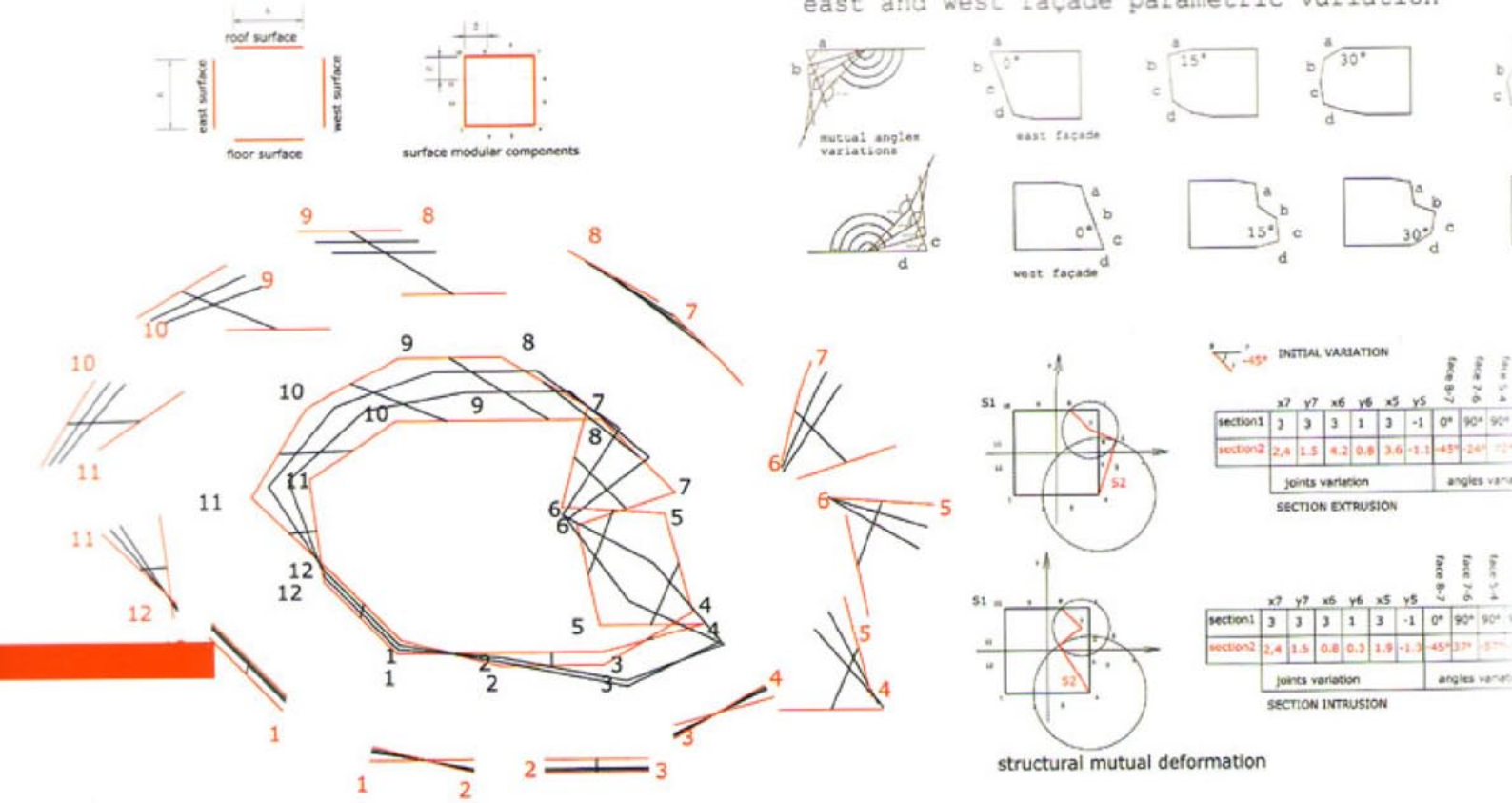
This is the stage in the design process in which a set of mainly environmental (ventilation, lighting, sunshine etc.) simulation software programmes are experimented with in an innovative way, in order to assess the performance of each of the three-dimensional models generated from the initial configuration of the prototype. Structural, energy and comfort ratings are analytically compared, keeping carefully in mind the fact that any results obtained in a multi-parametric setup are a negotiated attempt to achieve the best overall performance possible. In actual fact, these analytical assessment systems merely help the designer to choose from the catalogue the model most worth developing in terms of overall performance and hence improving, and which to ignore.

There is still plenty to explore in order to assess the real potential of this holistic approach to architectural design. The application of new generative (generative genetic algorithms) techniques, the introduction of certain principles of biomimetic engineering, and the possibility of incorporating these principles in industrial processes. In any case this way of generating, selecting and proliferating forms in a specific context involves reconsidering notions concerning the efficiency, redundancy and sustainability of the built environment. In this respect, a phylogenetic (closer to biology than the usual use of this typology) cataloguing of the productive aspects of this process turns out to be more coherent and more in line with the logic of non-standard architecture.

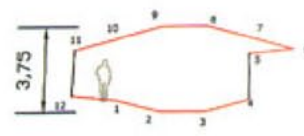
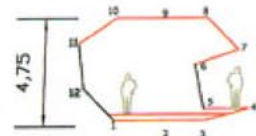
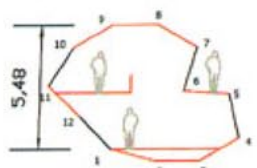
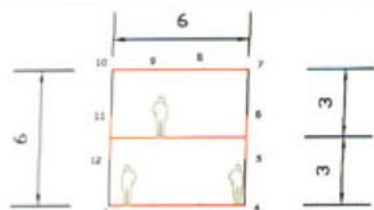
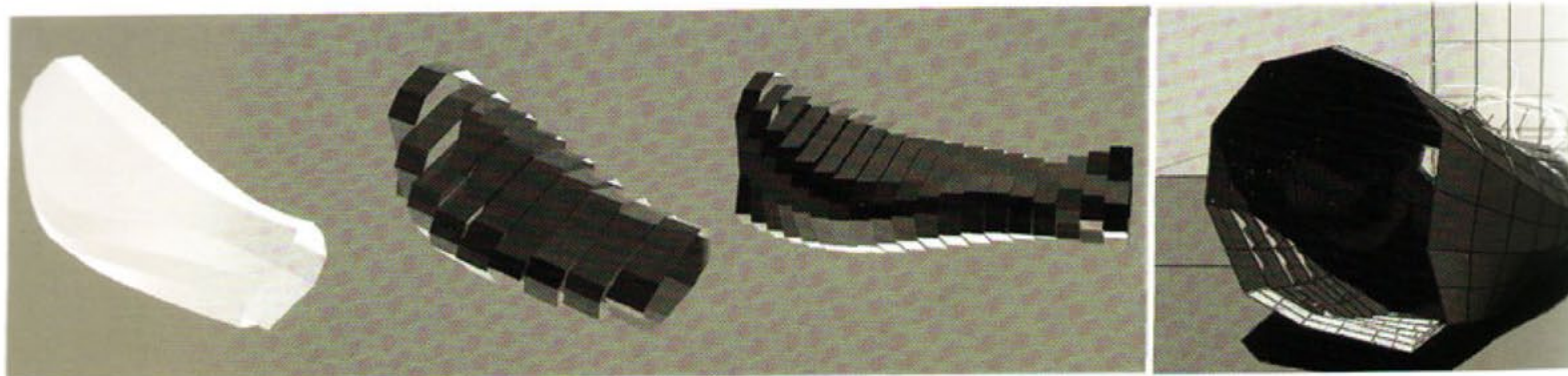
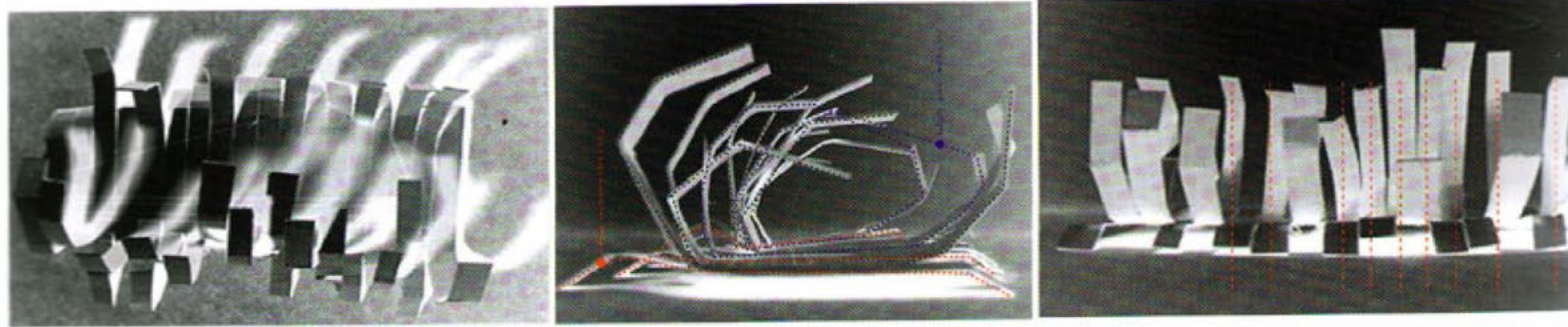
Without forgetting that: "Man invents nothing, he merely discovers principles embodied in nature and often manages to generalise these principles and then reapply them in surprising ways." (Buckminster Fuller)







sections making

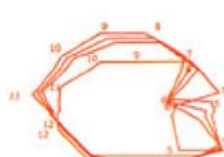
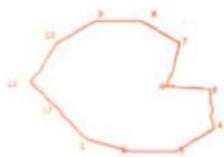


generative section

program 1 work/cook

program 2 living

program 3 sleeping

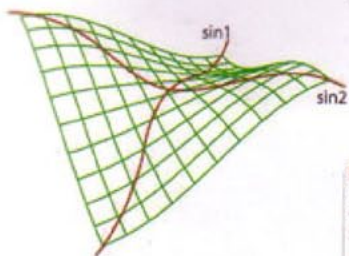


program 1 sec 3

program 2 sec 9

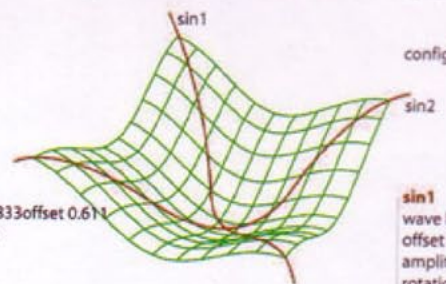
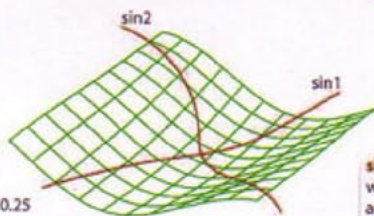
program 1/2 lofting

program 1 sec 4



sin1
wave length 3.5
offset 0.7 amplitude 0.25
rotation 0°

sin2
wave length 3.5
offset 0.7 amplitude -0.25
rotation 90°



sin1
wave length 2.833 offset 0.611
amplitude 0.05
rotation 20°

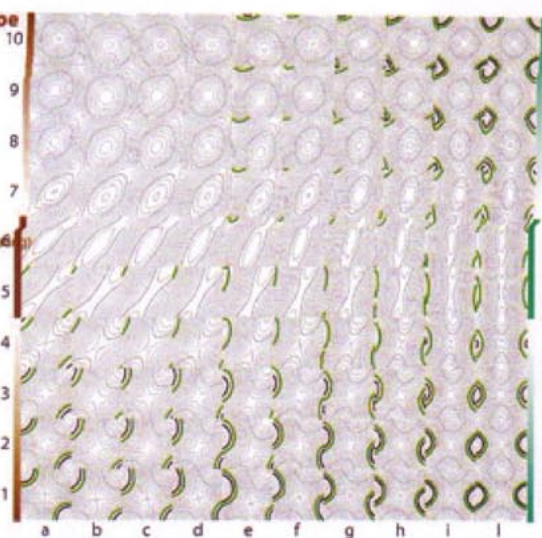
sin2
wave length 2.833
offset 0.611 amplitude -0.25
rotation 110°

sin1
wave length 2
offset 0.5
amplitude -0.25
rotation 45°

sin2
wave length 2
offset 0.5
amplitude -0.25
rotation 135°

groundscape

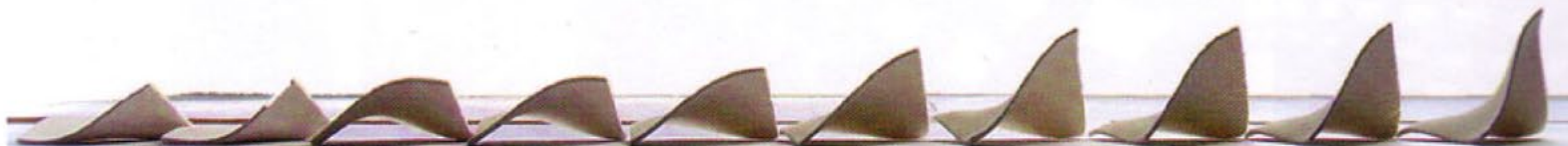
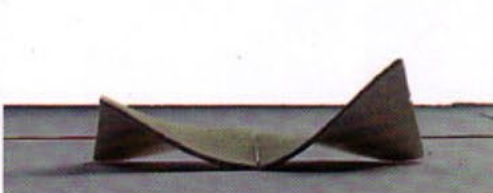
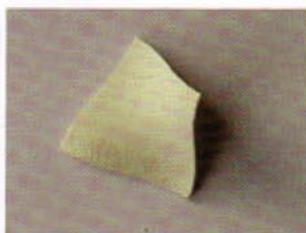
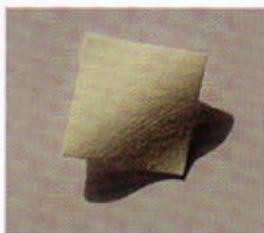
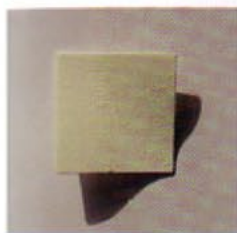
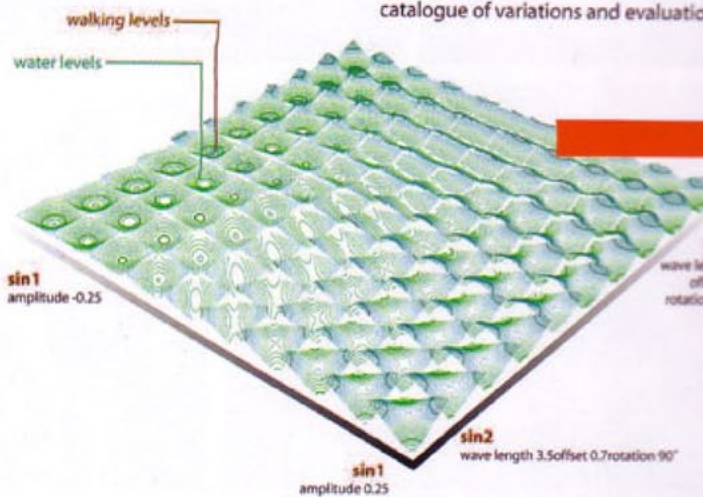
- rain collection
- water pools
- artificial dunes
- paths (walking, cycling, strolling)
- water cleaning streams
- seating
- water
- lighting



waterscape

- fitodepuration + stepping stones + floating platforms + jetties
- floating bridge + current accelerators
- waste collectors + current breakers + vertical connector

catalogue of variations and evaluation



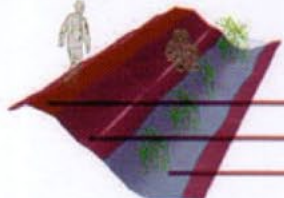
rectangular array
chopped at walking level

- rain collection
- stepping stones
- fitodepuration



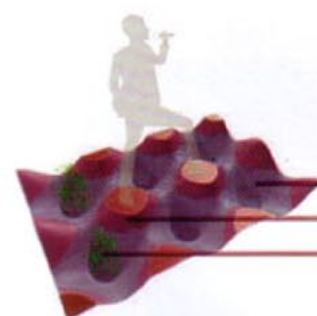
diagonal array
upside-down

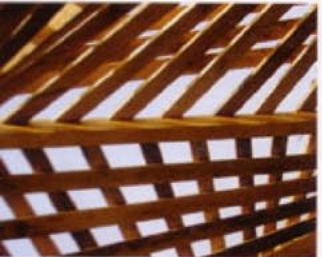
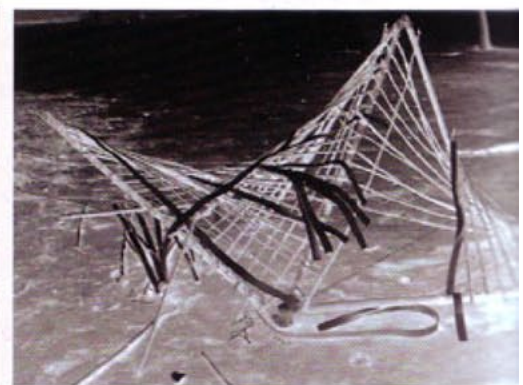
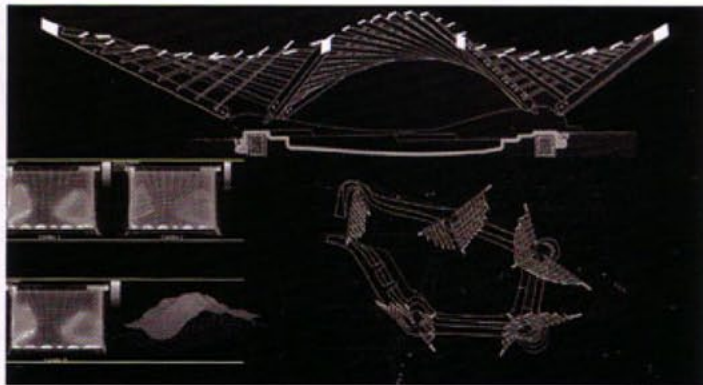
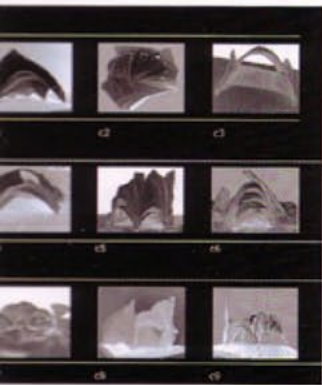
- water pools
- artificial dunes
- fitodepuration

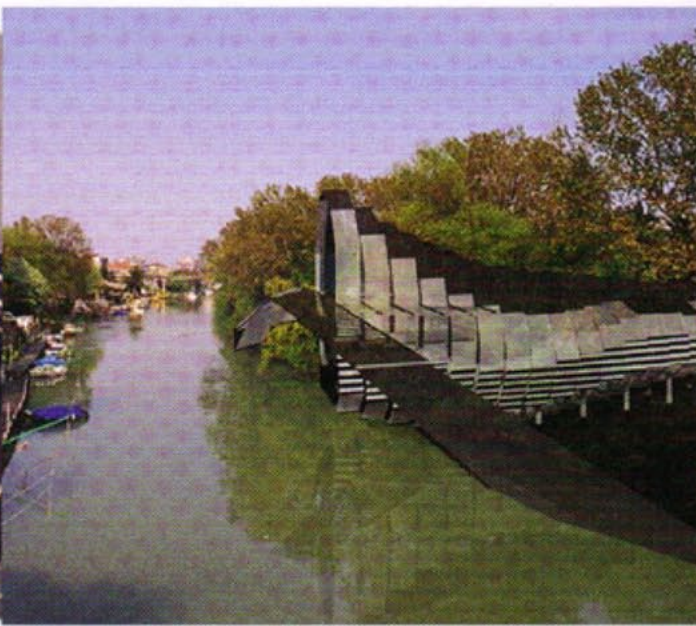
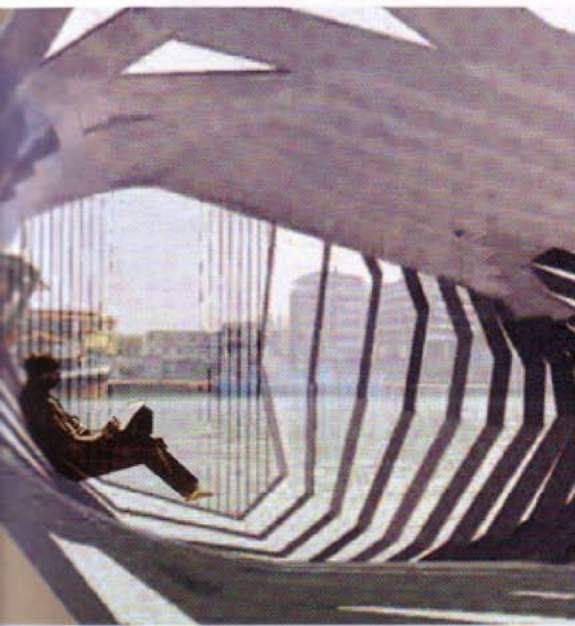


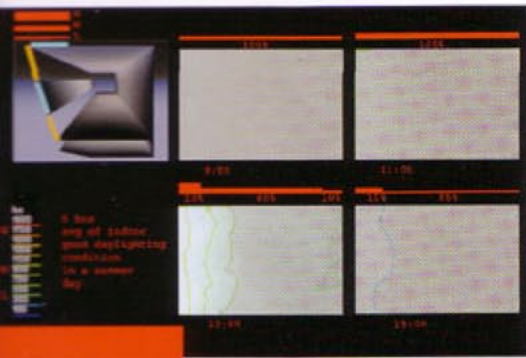
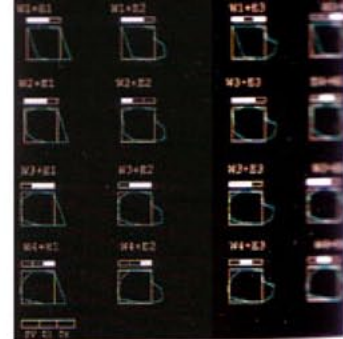
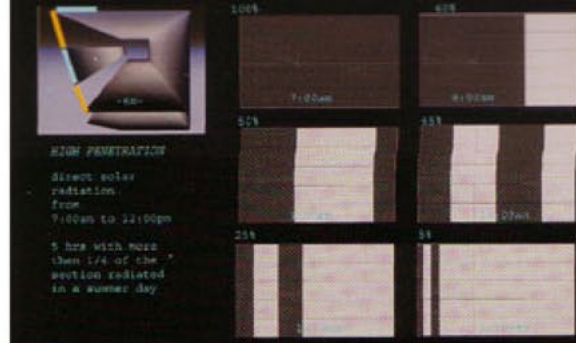
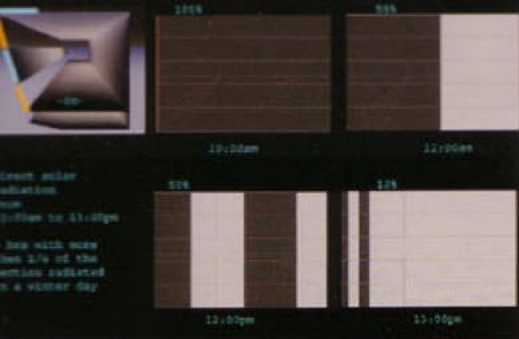
rectangular array
chopped at walking level
upside-down

- floating bridge
- seating
- water cleaning streams









		E1	E2	E3	E4
DAYLIGHT	S	10 hrs	7 hrs	10.5 hrs	11.5 hrs
	W	5 hrs	4.5 hrs	5.5 hrs	5.5 hrs
DIRECT	S	3 hrs	2.5 hrs	3.5 hrs	4 hrs
	W	5 hrs	4 hrs	4.5 hrs	5.5 hrs
PV		203,8 kWh/year	281.4 kWh/year	334 kWh/year	341 kWh/year

