The Probing of Complexity

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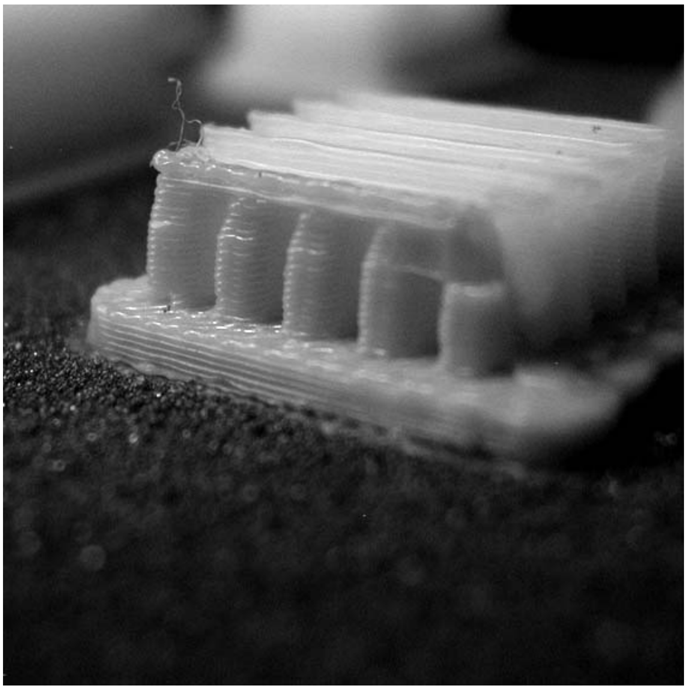

Miniature 3D- print made by the author

Abstract:

It is problematic to import models of complexity developed in the natural sciences too directly. The scientific models and their techniques needs to be reformulated once they enter into the domain of architecture. A current example of the problem is the role that the scientific fase-portraits of the dynamics of nature play in the particular field of contemporary architecture that is concerned with computer-generated form. The portraits are often treated as pictures to be emulated rather than diagrams describing events in a complex system. Paradoxically the imagery seems to serve as a justification for a form-oriented expressionism.

A basic premise of a complex system is the fact that it emerges through the actions of simple operations in a complex environment. The emergence of complexity is always a question of how a given heterogeneous exteriority is approached. The complex system is not produced through the unfolding of a complex code or mechanism. There is consequently no decisive connection between complexity in the performance of architecture and the development and use of contemporary technology in its design. That is an illusion partly created by the importance of computer-simulated processes in the natural sciences and their uncritical translation to architecture. It is therefore important to divorce the concept of complexity from the tight marriage to contemporary technology and focus on the fundamental premise that both methods and techniques must serve as probes of a complex environment. In this sense the morphological issues always carry an ethical dimension as its fundamental productive relation.

When the complexity concept appears in the current discussion of architectural issues, its use is based more or less directly on natural science's description of complex and dynamic systems as they have developed in recent decades. It is a well-known fact that there has been a shift in the nature of the phenomena that natural science is able to describe. With the aid of computers, regularities in phenomena that were previously perceived as chaotic have been detected and mapped. The allusion is to the fields of chaos and complexity theories. There are great differences as regards the extent to which the reference is derived. Whether it seeks to adopt a procedural model from science, or whether it applies computer technologies to describe complex systems in connection with architectural design. The transformation from a scientific domain to architecture's domain is, as always, productive, because it offers new ways of understanding architecture's different processes and makes new technologies available. And as always, the transformation is also problematic. One of the dangers is that scientific models for complex systems' function are adopted too directly and implemented as a sort of methodology in architectural practice. Furthermore it is sometimes evident that the understanding of natural science models is too inadequate and that science is merely used as an alibi for an architectural position, which does indeed use concepts and technologies that would be unthinkable without scientific development, but which does not take the full consequence of the scientific experience and therefore in reality uses it as an alibi for a formal interest, an already existing aesthetic.

The objective of this text is to discuss the relationship between natural science and architecture within a specific topic in the hope that through this, a construct will be presented that is relevant in other architectural topics. The object of the text is to critique certain formal characteristics of the computer based design that draws its inspiration from scientific models.[1] The object is partly to demonstrate that in some respects, no consequence is taken of natural science sources, but also to outline a use of the scientific references that do not primarily focus on the technological aspects of development, but seek to rephrase scientific concepts into architectural constructs. Hopefully, this will indicate that it is not the novelty value of technologies that is decisive, but rather their ability to work with, vary and maybe rephrase already existing architectural questions.

In his article *Deleuze and the use of the genetic algorithm,* Manuel DeLanda discusses a number of common conditions in architectural design methods, which use experience from science's description and simulations of complex systems in nature. In that context, he identifies three conditions that are decisive in such an architectural design process.[2] These are: 1) population, 2) intensive processes and 3) topology.

The first item originates in the fact that in connection with morphogenetic processes, one should always consider the quantity in relation to which the development takes place. The quantity is not a stable mass, but in constant motion and flux. In other words: a population. One must think in terms of dynamic quantities and in the mutual interaction of the parts. It is also decisive that the development emerges. This means that the process grows in complexity because it takes place in a complex environment. However, the individual actions or operations are simple. In that respect, emergence is radically different from a more traditional teleological process model in which the germ of

[1] Naturally, the field is too extensive to be dealt with in one go. Many of the circumstances critiqued here will already be the objects of discussion among different professional groupings. This is why the critique is directed at specific formal characteristics that occur across the individual design strategies.
[2] DeLanda, Manuel. “The Use of the Genetic Algorithm in Architecture”. From the anthology *Contemporary Techniques in Architecture,* (Architectural Design Profile vol. 72, no. 1, January 2002), p 10.

a seed is described as if it carried the tree in its code, and the process is seen as the unfolding of the germ. A given development, seen through the perspective of the emergence model, cannot be understood unless the environment in which the development takes place is considered at the same time. Therefore, the architectural design process is often put together as if it were a simulation of an eco system. The process is based on an extensive number of parameters that serve as the diversity of the eco system.

The next item deals with the difference between intensive and extensive properties, which originally stem from thermodynamics.[3] If a given amount of water is divided into two equal parts in terms of volume, the temperature will not change, whereas it would be obvious that the volume is halved. Volume is one of the extensive properties. Weight is another. Dividing at the extensive level does not in itself produce a change of condition in the water. If, on the other hand, the substance is divided on the basis of its intensive properties, the situation is different. The change in the water's temperature can produce radical changes in its substance. As the water gets closer to boiling point, increasingly more complex turbulences are triggered, which finally result in an actual symmetry break,[4] whereby the water turns into gaseous form with the radical changes of volume that this entails. This means that a system's intensive properties cannot be changed without sparking off a dynamic process that changes the system's extensive properties. At times, the change is so significant that an actual phase shift takes place, resulting in a symmetry break in the system, such as the water's evaporation. Temperature, density and pressure are all intensive properties.

If the terminology is to be transferred to the architectural design process, it means that the creation of architectural form advances as the productive relations are studied in the virtual environment that has been constructed in the computer.[5] A simple example is the translation of an organic computer modelling into a concrete structure based on mutually different building components. Here, the form is like a fine mesh cloth characterised by different forces and their translation into manageable parameters. A change somewhere in the form sends an effect through the components, which all change a little. The field of related design strategies is vast and populated by far more complex structures of virtual environments in which forms are precipitated. But in all cases the radical shift in the designer's position is due to the fact that he does not first create the designs directly, but instead takes on the role of the person who cultivates the growth of the forms by caring for the details of the processes and paying attention to a world of vectors and forces assumed to precipitate the forms. Gaudí's famous experiments with the vaults for La Sagrada Familia are, in many ways, an early analogue example of such a work process. Suspended cords and the different

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[3] Ibid, p 69. DeLanda quotes the following definition from Van Wylen, Thermodynamics, p 16: "Thermodynamic properties can be divided into two different classes, namely intensive and extensive properties. If a quantity of matter in a given state is divided into two equal parts, each part will have the same value of intensive properties as the original, and half the value of extensive properties. Pressure, temperature and density are examples of intensive properties. Mass and total volume are examples of extensive properties."

[4] Prigogine, Ilya and Stengers, Isabelle. *Order Out of Chaos*, (Bantam Books, 1988), pp 160-167. (Reprint of original edition, 1984. Based on the French edition *La nouvelle alliance*). If a system is close to its equilibrium, it is not receptive to minor changes in the environment. If, on the other hand, it is brought out of equilibrium, it will react strongly to even small fluctuations in the energy inflow. Dynamic systems are always dissipative in the sense that they require energy to be supplied in order for them to display their regular behaviour. When approaching the point at which the system will undergo a change of state, or symmetry break in scientific terminology, the system will display a seemingly chaotic behaviour. It will undergo sudden changes between different values, so-called bifurcations, which will increase in volume, until the system changes and finds another equilibrium, where it is no longer sensitive to small changes in energy supply. The bifurcation cascades could, for instance, be the turbulence of water as this changes from aqueous to gaseous form during heating.

[5] Ibid, p 10.

attachment points constitute a quantity that is affected by gravity due to the different weights that represent the load in the subsequent structure.

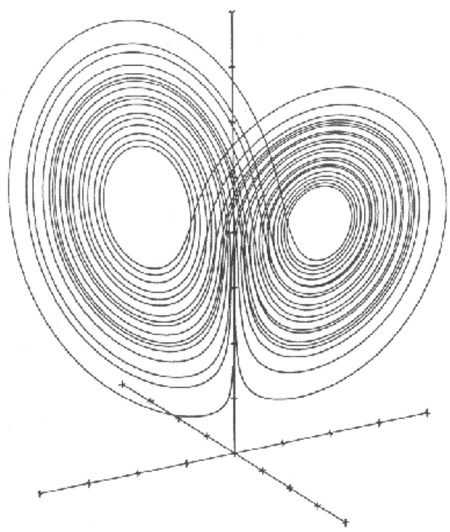
The first condition, concerning population, is relatively easy to handle, as to a great extent this can be achieved through the construction of a virtual environment of parameters on the computer. The second, however, is more complicated, because it raises questions about the relationship between the virtual environment – the simulation – and the real environment – the context and its life world. It is not sufficient to ascertain that forms can be created through the manipulation of parameters in the virtual environment. The text will continually come back to this issue, but first, the third item, topology, will be introduced.

When digital tools, which involve complex processes in the form development, are put into use, it would be obvious to expect that a diversity of architectural forms would emerge, which, if not immediately, then at least in the long term, would point towards diversity with a volume reminiscent of the diversity found in nature's organisms. Therefore, one might be puzzled by the relative homogeneity that characterises computer-generated form.[6] It seems that often, topology is identified with weak organic forms, which for the same reason tend to resemble each other. Paradoxically, topology, which seeks to describe the very relations, within modelling programs often becomes synonymous with a certain class of objects. The homogeneity indicates that in reality, it is a question of specific form-related codes, whose purpose is, among other things, to indicate a precise domain for an IT avant-garde.

Part of the problem has its origin in the way the typical modelling programs work. As Bernard Cache mentions, most forms are developed in a traditional Euclidian space.[7] The first piece of software, which is always left out in the account of the process, is the Euclidian geometry, which is the basis for the different form experiments. All you have to do is open the menu in a random modelling program to establish that you begin with a simple Euclidian geometry, which is then deformed through the calculation of NURBS – curves' course through space. Quite simply, a similarity between topology and deformation occurs as a result of the work process. Subsequently, it is important that typically, a computer-generated form is assessed via a perspective representation on the screen. Naturally, there are many ways in which to use a modelling program, but characteristically, a function is determined, which is to work on a given object or data set followed by an evaluation of the result in the form of an object produced by the process. As the evaluation often takes place in a perspective space, and the perspective has the effect that the observed is perceived as an object in a three-dimensional space, typically, it is the object's form-related nature that sticks out. It would therefore be reasonable to claim that the perspective contributes to identifying topology with a particular form world, and the degree of novelty with the degree of the form's expression. Moreover, it is paradoxical that the perspective space plays an important role as an evaluation tool for an architectural style that undoubtedly considers itself avant-garde given that the arts have long been trying to detach themselves from the spatial illusion of perspective. This is probably due to the style's dependence on technology and the blind angle that such a dependency typically turns on history and the profession's accumulated experience. As we all know, the fascination with technology often leads to a desire to recreate the world in its image. The fact that this also applies to this case, where the foundational experience ought to be that everything is always

[6] Ibid, p 11.
[7] Cache, Bernard. "Gottfried Semper – stereotomy, biology and geometry". (From *Contemporary techniques in architecture*. Architectural design profile 155, 2002). p 29.

situated in something, and that one has to consider its work as it unfolds in the given context, merely testifies to the captivating strength of the technology metaphor.



Lorenz attractor

The Copernican change in sciences today takes place through a focus on systems in the contexts in which they work. The conservative scientific model is about isolating a phenomenon as much as possible from outer influences. For the same reason, the system usually moves towards equilibrium. Modern day's chaos and complexity theories share the condition that instead, they investigate the possibilities of a dynamic equilibrium. Manuel DeLanda mentions the chemical clock as an example. If you mix a red and a blue liquid, you would expect that over time, a stable state would occur where the liquid is purple. However, there are examples of liquids that change rhythmically between being blue and being red.[8] The rhythmic equilibrium is conditioned by oscillations between the molecules, where they spontaneously change and move in the same direction in a self-organising process. As Prigogine says in *Order out of Chaos*, the substance is "blind" in equilibrium. Under circumstances that are far from the equilibrium, however, the substance becomes receptive even to weak forces,[9] e.g. gravity. The reaction to the weak influence is a change in self-organising patterns. The self-organisation presupposes an extreme sensitivity even to minor fluctuations in the environment. Chaos is not aimless interference, but rather unpredictable shifts in self-organising processes. In a sense, chaos is an excess of creation, whose parameters are so extensive that the shifts become impossible to predict. Thus, complexity is a limited section of a more comprehensive complexity: chaos.

If it has not previously been possible to examine dynamic processes in detail, this is largely because it requires comprehensive calculations. It is thanks to the computer that

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[8] DeLanda, Manuel. "Nonorganic Life". The essay is a contribution to the anthology *Incorporations* by Jonathan Crary and Sanford Kwinter, (Zone, 1992), p 130.

[9] This can be found in different ways in the book, but the following presents it e.g. in relation to the termites' construction of a nest. This is one of the frequently occurring examples of simple units that create complex structures. Prigogine, Ilya and Stengers, Isabelle, *Order Out of Chaos*, (Bantam Books, 1988), pp 181-189. (Reprint of original edition, 1984. Based on the French edition *La nouvelle alliance*).

today it is possible to simulate processes that it would have been impossible to calculate using traditional means. Its image of a dynamic process is called a phase portrait. The portrait is constructed by establishing a phase space with as many dimensions as the given dynamic system possesses. The number of degrees of freedom determines the number of dimensions, i.e. the ways in which the system can be changed. The pendulum has two degrees of freedom: its speed and its position. The bicycle is more complicated as, due to its many different mechanical parts, it has about 10 degrees of freedom.[10] It goes without saying that the number of dimensions in the phase space can quickly increase dramatically as you start studying more complex systems. The portrait is drawn as the computer calculates the way in which the system develops over time. In concrete terms, this happens by the computer drawing trajectories that correspond to the system's development in the phase space. The Lorenz attractor above, which is one of the well-known phase portraits, describes the turbulence in a weather system.[11] It is important to note that the portrait should not be seen as a representation of turbulence despite the graphic whirls, but as a mapping of a series of changes of condition where a periodic repetition turns into another and back. When the computer's calculations result in a graphic representation of the process, it is not an image in the sense that the graph depicts the principle of the natural process, but rather a map of the conditions that determine the development of the process. In other words, it is a diagram of changing conditions and not an image of the rotations of turbulence. The distinction is essential, not least in relation to the ways in which nonlinear processes are involved in an architectural context, where the seductive images of dynamic processes are often translated as if they were images in the sense mentioned above.

Of course, this should not be understood to mean that architectural projects refer directly to the phase portrait diagrams, but rather that the portraits contribute to forming a common cultural image world of nature's dynamics, to which the projects refer, more or less deliberately. However, a conversion takes place if the computing power is not used to outline a complex phenomenon outside the computer, but to create a form based on the given parameters, which is subsequently to be realised as a building. In connection with natural science simulations, scientists are aware of the fundamental difference between a computer simulation and the actual environment. The same cannot always be said within architecture, where simulation is often translated to be built directly. Often, attention is focused on exterior appearances and these are used as representations of properties. And because it looks like nature, no longer a *belle nature*, but a nature in constant change, the image seems to share nature's intensive processes. However, mistaking simulations for architecture corresponds to mistaking the graphic representation of a Lorenz attractor for a weather phenomenon.[12]

It is important to distinguish between technology and technique as different ways of applying architectural tools in the field between media and production forms. Technology tends to gather tools in cohesive systems and works best without the unpredictability of material. This is why, in the course of technological development, homogenous materials have typically been used: pure homogenous iron, for instance, is a clear example. Naturally, this is not the case in more recent technologies. They, on the other

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[10] DeLanda, Manuel. “Nonorganic Life.*”* The essay is a contribution to the anthology *Incorporations* by Jonathan Crary and Sanford Kwinter, (Zone, 1992), p 136.

[11] Gleick, James. *Chaos* (Vintage 1998). (Reprint of original edition from 1988), pp 11-31.

[12] The computer is close to being the ultimate product of art as it is almost exclusively determined by its performance, as indicated by Herbert A. Simon in *The Sciences of the Artificial*. This is also why certain branches of the technology-based experiments of today study the interface between technology and its concrete context as a way of developing a hybrid body somewhere between installation and architecture. However, that is not the topic here, as the intention of this text is to release the complexity concept from its close bond to the new technology.

hand, tend to return to a simulation of the intensive environment. The simulation presupposes the translation of the influences from the environment into quantitative parameters that the computer system can handle. However, it is an inevitable requirement that the process in a complex system is driven by intensive differences.[13] If intensive differences in the context are reduced to parameters, they are reduced to extensive differences in degree. It is tempting to believe that it is the figurative identification of topology with deformation that determines the reduction of the context's intensive properties to quantitatively determined forces, which can be used to deform a given form. Gregg Lynn's project *House Prototype in Long Island* is a good example of how a series of form experiments is developed across an environment of force influences and a simple type, which is deformed in different ways in accordance with the varying force influences.[14] Characteristically, the establishment of the virtual environment takes place via a translation of various parameters related to the context, e.g. coastline, adjoining house, vegetation etc. into a series of vectors that pull at the subsequent type with differing strengths. The actual type's relation to the life form is not a primary study, but rather a coincidental result of the deformations. For the same reason, the deformations tend to simplify the type as otherwise it would counteract the deformations' free unfolding and subsequent evaluation.[15]

In contrast to technology, technique should, to a greater degree, be understood as a practice. Techniques are developed in relation to a complexity that is external in relation to the actual technique. The complexity is found in the material, or in a wider sense in the environment in which the technique works. The traditional crafts stand out as techniques in this sense of the word, as they develop precisely as an examination of a complex material. This applies to the carpenter's knowledge of the wood's tensions and the blacksmith's knowledge of the folding of iron. Technology, on the other hand, organises tools so that its system can be repeated across concrete situations. Technology seeks to simulate diversity through combination. It is no help in this context that technologies have become more intelligent. This only seems to renew the technology myth. The real diversity involves a continuous change of the system. Such a continuous transformation is characteristic of the way in which a practice such as a traditional craft is developed, while its examination of the complex material is slowly refined. Technology focuses on the tool, while the technique uses the tool to probe the differences in a complex material.

In continuation of the above description, it is worth mentioning that when the complex system is seen as a desirable element in contrast to the simple, it is because it contains a greater number of degrees of freedom. It permits more actions and more events. In a way, it is the opposite sense of the word to the everyday and slightly condescending use of the concept, where it describes something that is hard to get at or even hermetic. If the complex system is hard to master it is because it does not repeat the same but constantly transforms its structure. This is, however, precisely a symptom of the way in which it is entangled with the world.

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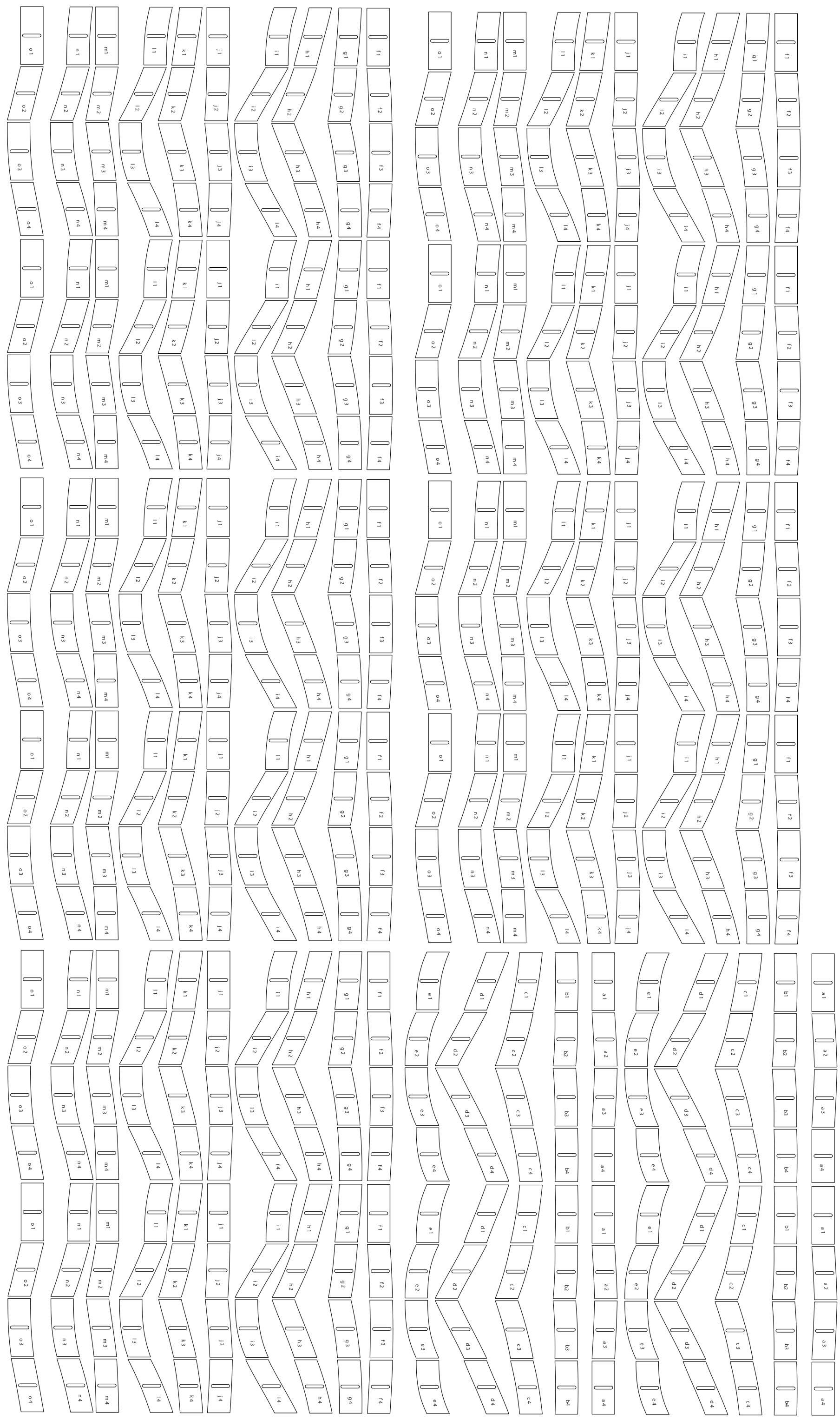
[13] For a brief introduction to various recent applications of the concept of 'place', see "Place: Permanence or Production", which concludes with a context description that is a continuation of this section, as the context is linked to the event. Solá-Morales, Ignasi de. "Place: Permanence or Production." *Differences*, (MIT Press, 1997), pp 93-104. (English translation of *Diferencias. Topografia de la arquitectura contemporánea* by Graham Thomson, Editorial Gustavo Gili, 1995).

[14] Lynn, Gregg. *Animate Form,* (Princeton Architectural Press 1999). pp 142-163.

[15] The relationship between the hi-tech media and the hi-tech manufacturing forms is too extensive a subject to discuss here. It is, however, characteristic that the relationship is often seen as a technological issue. This results in a question about how a form-related expressivity established in a modelling world can be coordinated with intelligent manufacture. In other words, it is a realisation issue that seeks to recreate the expressive forms as best as possible. Without the forms' curvatures, you have nothing.



Drawing of a series of components made to be cut by a laser

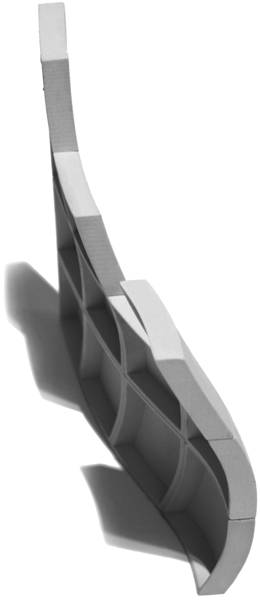
The drawing on the previous page shows a drawing used to cut an extensive series of two-dimensional components by means of a laser cutter. The parts can be joined into the drop-shaped model shown on the following page. The model is a draft for one of several models executed by the author to be presented at an exhibition at the Royal Danish Academy of Fine Arts, School of Architecture. The final version will be of a size and character that places it between the scale of the normal architectural model and the actual building part. It is at one and the same time too large to be an outright representation and too abstract to be a building part. In many ways it is a general condition for a large model that it is capable of retaining the architectural model's reflexive potential and be tangibly present in the space at the same time.

Initially, the form is made as a simple transformation of a plane surface into a convex surface. This is among other things a reference to the commonly used and simple example by means of which topological geometry is communicated, according to which the square and the sphere are identical because they can be transformed into each other. In other words, from a topological point of view, nothing has happened by the deformation. The normal procedure would be to translate the modelled form into a concrete form. In this case, this has happened via the splitting of the modelled form into a number of cassettes, which have subsequently been printed on a 3D printer using a modified form of plaster. However, the same elements, which are shown below to form the drop-form, have been reorganised in accordance with a simple set of rules so that they are joined differently in relation to that which the form dictates. In general terms, they retain their original position, but they have been turned in relation to the local alignment. Rather than drawing the drop directly, the individual elements position themselves in relation to the form's curvature with various minor deviations depending on the local conditions. The form is rather a tendency, or an attractor if we are to remain in the scientifically inspired language, that is never fulfilled. Each element orientates itself in relation to its own local space, while at the same time it forms part of the combined multitude.

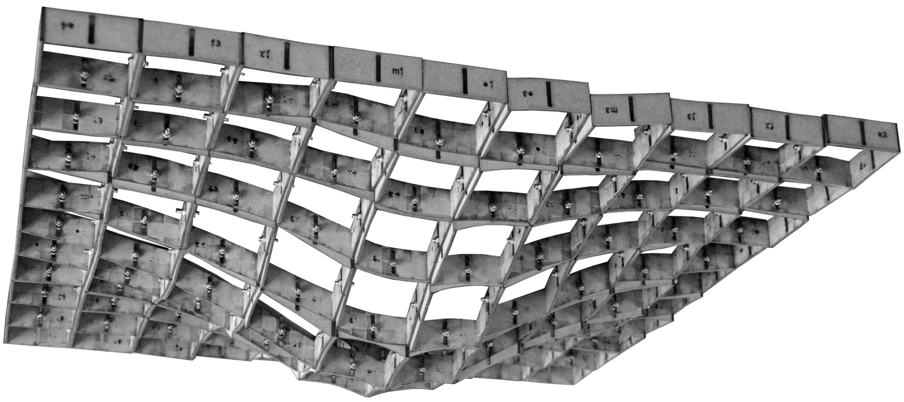
When the form seems to be suspended on the edge of a breakdown, this is a figurative and thus decorative effect. It distinguishes itself from the figurative references to a dynamic nature that is characteristic of the kind of formalism described in this text partly because it does not accelerate the forms' unhindered growth and deviations. The imagery of the drop has clear references to a well-known architectural type, the dome, and it can, among other things, be seen as a continuous transition between pendentive and dome. In doing so it relates to the traditional role of the pendentive as a mediator between square are circle. But it does so in a way that interchanges or blurs the categories. It would be accurate to say that it expresses a refractive encounter between an architectural type and a force world. The suspended dome balances on the edge of a breakdown: the moment of the drop. If it seeks to express anything it is the fact that the most productive encounters take place on the edge of an unmanageable influence.

The decisive difference, however, is that the structure as a whole is determined by the local joints. The form does not determine the individual part. It is rather a negotiation between part and form. The form is crystallised by the individual joining operations. It emerges, if we are to continue in the scientific terminology. In this case decoration is not merely an expression of an inherent constitution, but a way of joining the individual parts. To decorate is to construct from the bottom up. It begins with the smallest parts and cultivates the larger structures through the process.

For this reason the construction is not governed by a specific imagery. Rather the figurative aspects are derivative and in a sense liberated themselves. For this reason the construction becomes metaphorically enriched. The strongest metaphors are the ones that seem to establish the largest number of possible connections to other things.



Segment of the drop



The drop assembled

In many ways, modern day's focus on technology's simulations of the world's diversity would seem to have overlooked the simple fact that it is a condition for the complex system that it is exposed to exterior influences, which forces it to develop. In order to illustrate the difference between intensive properties and their translation into measurable parameters, attention could be drawn to the Japanese measuring systems: *kyo-ma* and *inaka-ma*. This example is deliberately of an earlier date in order to separate complexity from technology, but also in order to shift focus from a form-related complexity to the work and effect of architectural forms in a life world. The real topological investigation should unfold itself in the refraction between architectural form and forms of life.

There are two measuring systems in traditional Japanese architecture, which exist side by side.[16] The first is *kyo-ma*, which is defined by the tatami mat's module, where the standardised division of the floor's surface determines the position of the columns. The other is *inaka-ma*, where the building's dimensions are defined based on module lines, which are defined by the centres of the columns. As the first of the two, kyo-ma was emerged in the city, while inaka-ma developed in the country. Inaka-ma is easier to handle from a standardisation point of view, as the module lines guarantee that the building's different components are identical, while the kyo-ma system, although it standardises the tatami mat, subdivides a wall's thickness according to the room's size. Therefore, kyo-ma is more difficult to handle and presupposes a higher degree of specific craftsmanship solutions that are adapted to the individual situation. One of the reasons why inaka-ma developed outside the city is probably that it was easier to implement a general measuring system independent of the complex urban context. As inaka-ma was appropriate in connection with the production of building components outside the construction process, the system gradually gained acceptance in the city. Offhand, there is no great form-related difference between the two construction methods. Therefore, the distinction would seem to be secondary. However, there are certain spatial advantages in connection with kyo-ma, as the smaller rooms are more appropriate in relation to the body's proportions. And more than anything, the measuring systems vary as regards the relationship between dimensions and components. With inaka-ma, the building system is established in a general and homogenous space. The measuring system defines module lines that determine the size of the components, and the system is, in principle, developed independent of the concrete place. In other words, this is a perception of the building system that counterbalances the one that has characterised the 20th century in the West. Kyo-ma, on the other hand, relates the building to a number of actual sizes or components, if you like, which are on the edge of or outside its structure: the tatami mat and the city. In a sense the building emerges in the intensive field between the mat and the city. It is exactly this kind of difference between the two measuring systems that does not need to result in a radical form-related break, but rather in an a focus shift and another way of perceiving the object, which is the new technologies' real potential. From the metrics' measuring of the world in relation to an external system to topology's attention to dynamics in the concrete measurements and the fitting together of components.

Architecture is always situated as shown in the example above. Its forms are always placed in a life world, and distinguishing between intensive and extensive properties should direct attention to the interchanges between architectural forms and events in the forms of life. If there is any correlation between a phase portrait and an architectural drawing, this is not because the drawing mimics the portrait, but because it is drawn with attention to the forces in a life world. Gaudí's experiments with parabolic cords contain

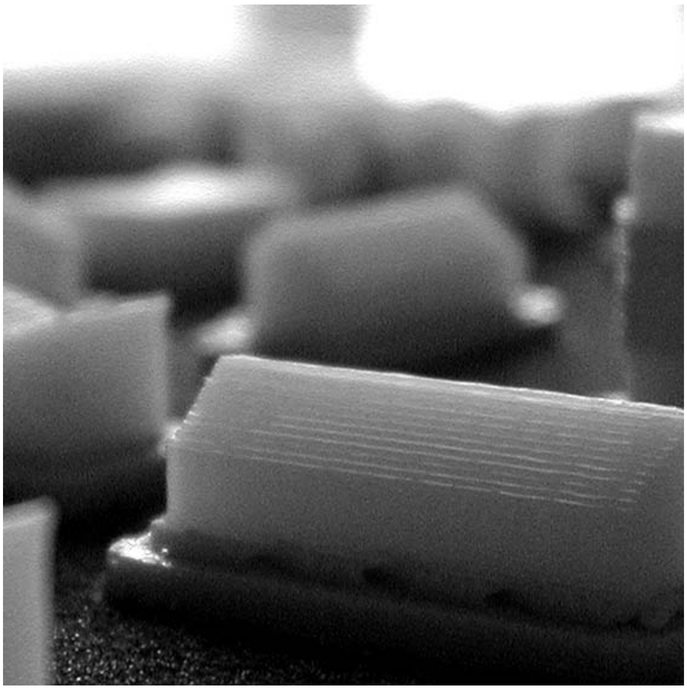
[16] Engel, Heino *Measure and Construction of the Japanese House*, (Tuttle Publishing, 1985). pp 36-42.

an extra and decisive level in relation to the examination of the different form options. Just as the experiment can be seen as a question of structural optimisation, it is also directed at an architectural type and through the joining of vaults to the interior of a church and its gathering of people.

All this leads to two essential matters. First, the new technologies ought to lead to a renewed contextual attention that teaches us to distinguish between intensive and extensive properties. The architectural context is a complex environment of intensive differences as regards the mutual influence between built forms and life forms. Therefore, the question should be: How can the new technologies function as techniques and probe an exterior complexity? The crucial experience gained from distinguishing between intensive and extensive properties is the fact that the tools are probes by means of which an exterior complexity is examined. The complexity is outside the tools. There is no doubt that the answers will come from professional positions that are anything but heroic for the simple reason that they all have other agendas than technology itself. What is required is probably a much more pragmatic and unheroic approach to hi-tech that is not fascinated by its intelligent muscles.

Second, there is the role of topology. The decisive condition that should constitute the primary study for an architectural topology is the relationship between the aesthetic work in the architectural media and the forms' encounter with a life world. This relationship outlines the profession's ethical dimension. In relation to the media, the relationship is a foundational condition that distinguishes the architectural drawing and the model from other drawing and modelling forms within the arts. The architectural drawing is present as an object with it's own properties. But at the same time it is giving measure to something that it not yet there: the building. It is this split between it's actuality as a drawing and it's relation to the building that is characteristic for the architectural drawing. Although this may be a trivial observation, it would seem to be absent in the more formal versions of contemporary computer-based expressionism because of it's reduction of the environment to manageable parameters. In a sense formalism translates the drawing to directly because it doesn't recognize and explore the difference. However, the criticism of formalism should not lead to the opposite position, in which all aesthetic experiments are attacked and reduced to formalism. One cannot do without the independent domain of the architectural media. It is precisely because there is a difference between the drawing and the life form that it is possible to experiment with the encounter whilst drawing. This is why this text persistently revolves around the role of the form without abandoning it in favour of other more pragmatic or anti-formal approaches to the profession. Without the aesthetic experiment ethics are reduced to morals. Ethics presupposes awareness towards life. Unlike morals it does not try to determine it's forms. Therefore the aesthetic work is important in order to challenge existing spatial charts. However, it should be performed with ethical attention to the life world that architecture encounters as an incorporated difference. Subsequently life sees its possibility in the building.

R. M. Schindler's own house from 1922 is a two-family home originally designed for Schindler and his wife Pauline and Clyde and Marian Chace. The house is built as two halves that meet around a common kitchen. In each half, there is room for the individual residents where they can work or stay as desired, and a toilet and bathroom. There is also a small roof terrace for each home, where the families can retire to sleep. The Chace family moved relatively quickly and made room for Richard and Dione Neutra, who lived in the house for a number of years, while Schindler and Neutra worked *together. The building continued to be the setting for extensive social activity as the two families attracted people from the American cultural society. In connection with large parties, the residents took advantage of the fact that the outer walls can be taken down in various places, creating a direct connection to the garden. After many years of living together, Schindler's wife left him and was gone for a number of years before returning to the building to settle in the half that originally housed the Chace family. Schindler kept living in the other half. As the Neutra family had already moved away, the former married couple continued to live together in the house they had originally built for two families, although they did not resume their married life. R. M. Schindler lived in the house until his death in 1953.*



Miniature 3D- print made by the author

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