



Digital *Techné* Santiago Albarracin

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ABSTRACT

More than a quarter of century of the advent of computers within architecture, it is time to set out new challenges and problems. One issue that has always been throughout these years, and particularly in the so called "parametric architecture", is how the projects are materialized, how is the step between the computer to the physical world. Nowadays, one can have several tools to carry out the materialization of a project, but to get a perfect shape, it stands firm, it wastes least material possible, that the material is adequate, these are facts that very few people achieve. Through the concept of digital *techné* we want to reveal how architectural offices carry out projects from renowned firms, which complex forms are only possible of represent thanks to parametric software, and also detect their main characteristics and skills that highlight them from the rest. To sum up, this article tries to broaden the Greek concept of *techné* within the digital contemporary context and its different actors.

KEYWORDS

parametrization, *techné*, construction, material, expertise.

1. DIGITAL TECHNE

The real issue is algorithmic complexity as a new model of matter, form, and behavior on a general scale. (Kwinter and Payne, 2008, p.231)

The digital complex has established within the architecture realm and it is time to set up new queries and new obstacles. Recent researches related to the digital and the virtual within architecture are related to material behavior, material performance, and the implementation of *big data* to analyze and predict behavior of different objects. The latter is being used for the development of *smart cities*, or highly complex solutions where multiple factors are involved.

While all of these researches are being carried out in the virtual realm, the issue that remains is how to materialize them, how is the step between the computer and the physical model, and how you develop its construction. In the last twenty years he have been seeing significant progress in these matters, and by the hand of young architectural offices, which have been experimenting with laser cutters, CNC machines, and 3D printers as tools to materialize their digital projects. These offices used to develop radical solutions in their projects, ranging from buildings to art installations. Provide technical advice is part of their job as well. They have the skills and the knowledge to determine the most effective way to build the object, since these projects usually present complex geometries; or from their researches they used to discover new materials; or are interactive installations beyond the most classic spectrum of architecture.

2. TOWARDS A DIGITAL TECHNE

Virtual space became a scene for speculation and reflection, for test, deforms, wrap, shape, and animate special sequences, that in another way, they would keep as static graphic images. Through their liquid nature, the digital space became a collaborator in the development of ideas and shapes, not just as a passive guest of preconceived forms or formats brought by recommended software. (Dollens, 2002, p.17)¹

Since the early nineties the computer has been adopted as a tool of work and its powerful capacity to develop complex process and calculation. Most of the users, of this computer programs, take this brute force to empower their projects. Through this tool the design and draft of many buildings was possible, and finally they were built.

At the beginning designers become astonished by the easiness they could develop free forms, which it has led, in some cases, to an excess or overuse of the tool.

By exploring the digital complex, throughout these years it has developed a capacity to synthesize new materials, and work with an exactitude that was not possible before. This has led to an update and deployment of new design methodologies, many of them have been used in an analogical way, making possible the arising of the architecture design by parametric software.

Techné does not mean art neither ability, nor much less technique in the modern sense; *techné* is the knowledge, there lies the true meaning of *techné*. *Techné* is an intellectual habit, this means that it is a principle of knowledge, its exercise leads to a kind of knowledge. *Techné*

¹ Free translation from the author. In the original "El espacio virtual se convierte en un escenario para la especulación y la reflexión, para ensayar, deformar, envolver, dar forma, y animar secuencias espaciales que, de otro modo, permanecerían como imágenes gráficas estáticas. A través de su naturaleza líquida, el espacio digital se convierte en un colaborador del desarrollo de ideas y formas, no sólo en un huésped pasivo de formas preconcebidas o de formatos dados del software recomendado." (Dollens, 2002, p.17)

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is wondering beyond what is established by experience. This knowledge has superiority, because it makes and underscores everything that can be accessible, interpretable, and intelligible; it is not a *techne* because its production implies technical skills, tools and materials, but because it is "knowledge that question" and "make it work".

In regard to architecture with complex shapes, where we see a lot of technique, but when it is time to materialize them the results are not the expected. Throughout these twenty years the results have been improving, even though these advances or solutions to materialize the projects have been found in environments not related to the hard core of architecture, otherwise on the side of engineering or the industrial design.

This digital revolution has established, and referred to architecture of suffering for a lack of a representative material, as the iron in the industrial revolution, the reinforced concrete or the glass in the so called modern movement in the first decade of the XX Century. All these projects of a digital design array with complex shapes have been built with traditional materials as bricks, wood, metal, or concrete. This often leads that the step between the computer screens to the finished building is not as faithful, and it present differences.

Architecture needs mechanisms that allows connect with culture. To reach this, architecture takes advantage constantly of the forces that shape the society as a reference material. And for that, its materiality is complex, compound by visible and invisibles forces. Architecture evolves in base of new concepts that allows it to connect with that forces and reveal in new esthetics compositions and new affects. These new affects allows it to stablish new relations with the city. (Kubo and Moussavi, 2006, p.1)²

There are very few buildings built in plastic or polymer to reach to a proper finish, but it size is very limited and its cost is very high, and this is why it is complicated to build it in a bigger scale. This lack of a representative material has led to find similar results with the materials that are available, generating a deep and rigorous research of their physical properties, and see how they can adapt to the projects currently in design. Material properties have begun to be a new "material" at the stage of design, and their properties are usually part of the parameters that affect the whole project.

Nowadays, robotics and many machines are part of a group of tools to work with metals and wood. These process are computerized, and they have brought the possibility to reach to a very accurate termination, but taking in consideration the limits and constriction of the machines. What respect to the digital parametric, it has reached a point of being able to predict the behavior of a material, and react in front of different stimuli.

3. DIGITAL WORKSHIPPERS

The architect is a worker, which its production mode is conditioned by the digital technologies, but the development of them should be natural. In this sense, software programming is at the same time the most important genre of the contemporary

² Free translation from the author. In the original: "La arquitectura necesita mecanismos que le permitan vincularse con la cultura. Para lograrlo, aprovecha continuamente las fuerzas que conforman la sociedad como material de trabajo. Y por ello, su materialidad es compleja, compuesta por fuerzas visibles e invisibles. La arquitectura evoluciona en base a nuevos conceptos que le permiten vincularse con esas fuerzas y manifestarse en nuevas composiciones estéticas y nuevos afectos. Son estos nuevos afectos los que nos permiten establecer nuevas relaciones con la ciudad." (Kubo and Moussavi, 2006, p.1)

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culture, and the privilege field for new confrontations of forces that organize the production of our societies. (Picon, 2009)³

While architectural office that are published here seems to be a model of digital *techne*, they are not digital native, but they embraced the digital as distinctive signature of their projects, and like an inevitable tool, if not it would be very hard to carried out.

All of them not always use the same software, neither have they had the same professional profile, but they share that capacity to carry out projects in the best way possible; we might say that they are part of the avant-garde architecture. Their professional profile range from more traditional offices that build in multiple scales and as a distinctive feature inside or their office they have a small group focused on research and study of new methodologies of design, that then they apply in their projects; till offices that take orders from artists, architects, enterprises, among others clients, to develop and carried out their designs and/or projects. The latter used to have a more heterogeneous staff, where architects, engineers, designers, and programmers mix between each other. There is still a third option, and it is the mix of the two options, they used to have a more classical architectural composition, building their own projects, and simultaneously carrying out external projects.

We choose four architectural offices as model that recreate different aspect of the digital *techne*, they are: SHoP architects, SO-IL, P.art (AKT II), y Aranda Lash. Is for this reason that we are going to review their projects as clear examples of digital *techne*, for which we are going to analyze them under four categories, as an essential part during the process of design and building. The four categories are: design, research, resolution, and construction. That a project appears in a category does not mean that it has not been taken into account in the other categories, but precisely these works stand in that category in which they have been placed.

4. DESIGN

Architecture as a material practice is mainly based on design approaches that are characterised by a hierarchical relationship that prioritises the generation of form over its subsequent materialisation. (Menges, 2006a, p.79)

Within this category, what calls our attention is how the employment of these new digital technologies are the one who encourage the development and the first ideas in the project. It should be pointed out the versatility and the wide range of the design concepts unfolded in the design stage, affecting the successive stages, but not in a linear way, otherwise setting up a continuous loop of feedback.

One of the projects that embody the spirit of the digital *techne*, and focus on how to revitalize and update the use of traditional materials, taking the digital materialization one step further, it is in New York, and it is called Mulberry House, by SHoP Architects. This project is placed in a zone where the current building regulations demands that all the facades must been built in brick, as it is throughout all the area. This is achieved, but at the same time its intention is to become unstuck from the past by deciding not to repeat the environment and give to that façade their personal touch, it has a soft undulation. The design of that brick façade brought several responses that the project was demanding, as to respect the current building regulation, maximizing the space with that modular panel used throughout all the façade, reducing the width of the wall and having a bigger surface to inhabit.

³ Free translation from the author. In the original: "El arquitecto es un trabajador cuyo modo de producción se ve condicionado por las tecnologías digitales, pero el desarrollo de éstas no tiene nada de natural. En este sentido, la programación de software es al mismo tiempo el género más importante de la cultura contemporánea y el terreno privilegiado para una confrontación de las fuerzas que organizan la producción de nuestras sociedades." (Picon, 2009)

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Heatherwick Studio, run by Thomas Heatherwick, was who design the British Pavilion for Shanghai 2010. This project was designed associated with AKT, which has a research group called P.art, which means *Parametric Applied Research Team*. P.art describes itself as a research group that instead of *think outside of the box*, they have decided directly to *throw the box away*. The researches of this group are part of the first stage of design till the construction stage; they work consist in the research of an original form, how to build it, or which would be the most efficient and economical way to build it, among others duties. Also to study each parameter that affects the project, and run simulations and predictions of how it performs.

The British Pavilion was a multi-awarded project, and not just by its shocking image and design, but also by the quality which has been completed. The project appears as a big cube, or box, which it is perforated by acrylic tubes, where each one of them has seeds from all the UK. These tubes moves, they are not statics, and during the day they let pass the clarity of the sun, and at night the tubes lights up with their inner light. This cube is placed over an artificial undulated landscape where people can lay down and have a rest; below this structure the pavilion carries out its promotional activities.

Aranda Lash was established in 1999, in the city of New York, and it is an office focused in the research and materialization of projects. Unlike its colleagues from Los Angeles, where they mimic cells structures and insect wings, Aranda Lash are more interested in the process than in the pattern. Instead of been worried about the material, their main concern lays in why the material assumes that particular state y how they could improve it. This characteristic places them one step beyond the rest. In spite of being an office where the digital production is strong, their way to materialize and test their projects is handcrafted.

5. RESEARCH

Digital performance tests are carried out in collaboration with external consultants. This involves many different software applications and operating systems, but more importantly each requires a different simplified representation of the model as the input to their analysis routines. (Menges, 2006b, p.46)

This stage is very close to the design stage, and many times they mix, but the important here is setting a path to move forward in the most efficient way. At this point, material, structural, and context issues become important because they can affect the project.

Foreign Office Architects (FOA) won a competition to design a John Lewis store in Leicester city center. Within the proposal there was a façade covered by an arabesque pattern, inspired in a store of the brand located in London. P.art developed this project, and the final proposal was that the façade images allows people inside the shopping center to see outside, but ate the same time from the exterior nobody could see them. This effect is produced thanks to the superposition of these patterns that alternate, are they placed in a double layer, achieving the desire effect.

After three years working together with Mathew Ritchie, Aranda Lash, and the structural engineers of Arup AGU together with Thyssen-Bornemisza Art Contemporary built *The Moring Line* project. It was conceived as an anti-pavilion, it should be ruin and monument at the same time, a drawing of and in the space, an open cellular structure. Initiating from a truncated tetrahedron it then configures in multiple architectonic shapes, scaled in fractal cycles and then carried to the multiple sizes. The result is a space where detecting the presence of people and at the same time with music played there in changes all the time.

6. RESOLUTION

My own model tries to posit matter as organizer: matter first, organization second. This model for architectural composition requires a different mindset of the designer. (...) Points, lines, and planes come laden with distinct qualities in measurable quantities such as density, pull, drag, tension, compression, acceleration, and porosity. These qualities and quantities, or properties, allow geometry to become behavioral and active rather than representational and passive. (...) Matter drives organization as physics draws the diagram. (Kwinter and Payne, 2008, p.237)

The resolution category is mainly focused in how to resolve and build the different proposal of the design stage. This stage activates that *loop* between the design and the final object.

SHoP Architects were the first to win the prestigious MoMA PS1 (*Young Architects Program, YAP*) award to young professionals, giving them the possibility to design and build a pavilion that will host the activities throughout all the summer in the courtyard of the museum. At a first glance, the winning proposal, *Dunescape at MoMA PS1*, has nothing that caught the attention, if we compared it with the others pavilions that had been built by group of students or in public events throughout the last years. The main key here is the date it was built. This project was built in the year 2000, more than ten years ago, and they employ machines, that nowadays are the average for that job, but in that time not. The pavilion was built with only one kind of wood strip, used in the whole project. When it was finished, it was a turning point in the office, and an important project to consider in the digital realm. In this project the possibilities of the digital parametric tools were taken to the highest level, to take the most advantages of a single object, like a wood stick, and generate such a spatial and programmatic variation.

Spiky, a project of SO-IL, is a canopy designed for the Fifth International Biennial of Architecture in China. The research began collecting information about the material available in the zone, and the final result was to employ a metal sheet to use it as a mesh that expands. Through several tests, the result was a geometric pattern that allows, to the metal sheet, to form 3 dimensional shapes and create modules, and when you match all of them the final result is the canopy. The way of assemble it, is with a metal sheet, which is laser cut, then it has a flagpole in the center that pushes, finally the canopy start to unfold. In this way is that a two dimensional metal sheet goes over to a three dimensional module. This module may vary from nine to twenty-five folds.

One of the first orders to Aranda Lash that had a huge impact was 1774, it was a furniture, and the final result was the mix of two overlapping data given in 1774, which it gives the name to the project. Louis XV died that year and a Swedish called Johann Gahn, discover a metal named manganese. To a molecular level when the oxides mix, the manganese shows a noteworthy super-crystal modularity. This project has been one of their first projects that place them in a higher level, not only by their resolution and completion, if not by filling out all the theory and digital production, with an artisanal materialization.

7. CONSTRUCTION

In digital tectonics scripting is used to produce geometric representation within the topology of the pattern or structure. Digital crafting is the ability to produce code that operates on the basics of such tectonic design modes. (Oxman and Oxman, 2010, p.20)

At this stage is, I think so, where the digital *techne* become more active, it is the moment where data and codes, that have been manipulated, are materialized; it is evident if they have

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made a master peace. Not only you need to know coding, but also bring it to reality. It is a typical feature in all these offices that sometimes they associate with other to reach that perfection and finish a project in the best way.

On the tenth anniversary of the *Design Research Laboratory* of the *Architectural Association* was hold a competition to design pavilion in the square in front of the university. The winners of the competition were Alan Dempsey and Alvin Huang, and their proposal was double curvature sheet, where furniture and the ceiling became part of the same object. Its apparent simplicity was one of the reasons why it was the winner. In the competition regulation it was stipulated that everyone have to employ a reinforced concrete panel with fiberglass of 13 mm. of width. The pavilion consist in rips of that material cut in a CNC machine, it was built *in-situ* with screw joints. This project was carried out together with AKT P.art.

K3 Kukje Gallerie, a project of SO-IL, is one of their most relevant projects and it achieved worldwide recognition. It is placed in Seoul, and the art gallery program is composed by exposition rooms, offices, and an auditorium. It is a big concrete box, where circulations, stairs, and lifts appear outside of it. In an attempt to break the box, that seems so heavy, and after testing different materials, the final determination was to cover the box with a grid of metallic rings, as if it was a mesh of a medieval warrior. The task is achieved, and the results obtained are of a great sensibility, with an impressive focus on the resolution of the details so that it can be built.

This mesh built by metallic rings welded manually, it is analyzed to a certain degree that the distribution of the structural efforts, which it is subject, is equal and has not more requested rings than other. To achieve this, they not only worked out with digital models, but also with physical models in scales as 1:10 and 1:1. The final result was a mesh that covers the gallery, giving a diaphanous image with a moiré texture, far from that monumental image that the building without the mesh would have.

Increasing the size of the projects, the *Barclays Arena*, a project composed by a sport facilities, with a big retail zone in New Jersey, was a project of such a great scale that SHoP Architects was not used to work. The key factor here was to in the reuse of a series of metallic panels, to design the whole building, reducing the material expenditure. The optimization in this project reach to such a high level that every piece of the building has its own QR code and you can scan it with an Iphone app especially designed for this. Every worker has one of this smartphones, and after one piece was placed they scanned it. This brought a very strict control of what was happening in the building site, because this app was constantly updating with fresh information. This project was design with CATIA, allowing the design of new panels, plus a further optimization of the existing one.

8. IN CONCLUSION

The work of these four offices, weighed up in this four categories, urge to sum up and represent in the best way the digital *techne* concept that we have been unfolding throughout this text. We appreciate that it is not something exclusive of the architects, or a particular office, if not that many of them are connected and they used to work together. It is clear that the projects of these offices carried out, they have no restrictions of any kind, and they design from furniture to buildings. It is in their experience and knowledge where lies that *plus* that highlight them from the rest. We only named just only four offices, but there are more of them that embrace this spirit of the digital *techne*.

Also we omit the universities where many of these offices partners used to teach, are invited professors, or have a consultancy role. These academic environments used to work as independent laboratories to develop new design methodologies and where they test new materials.

The projects that have been mentioned in this text go beyond technique, they are the result of experience, research and the skills of the one who designed and built them. They are projects

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that raise questions, and have a proactive attitude and aim for excellence not only from the digital and the parametric, but also in the materialization of themselves. Alejandro Zaera Polo and Farshid Moussavi make it clear when they said "*architecture is not a plastic art, but the engineering of material life.*" (Zaera-Polo and Moussavi, 2006, p.123)

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