

# Digital as a Tool/Reference for Architectural Conception

## Examples from Two Agencies: Ateliers Jean Nouvel and Jakob+MacFarlane

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**Abstract:** *This paper aims at specifying how ‘digital’ acts in contemporary architectural design. On that purpose, and in an a priori manner, we will formulate hypotheses of concepts able to translate the specificities of digital design. In this research paper, we beg the question that the ‘digital culture’ may influence the architects in two manners: in design operation and in references. The conceptual tools will be given by architecturology, and our hypotheses will be illustrated with examples of two French firms (Ateliers Jean Nouvel, Jakob+MacFarlane).*

**Keywords:** *Design; digital; space of reference; metonymic reference; metaphoric reference.*

### Introduction

Whoever having interest in the architectural conception can think that the digital tool has become an obligation among the tools utilized. From a help to represent and communicate, the computer has become a generator of shapes or even builder of buildings elements, as it is used by French architect Bernard Cache.

The considerations of the conceivers for the tools vary. Ben van Berkel (UN Studio) reports the following: “The new thing about conceiving with computers is that we no longer have to opt for a particular system. We can combine a number of principles to achieve far more complex results” (<http://detailtopics.com/digital-architecture/en/discussion/interview-ben-van-berkel/>). The opinion of this well-known architect is not isolated; numerous agencies

throughout the world have been using the new fields opened by digital tools.

Despite its conciseness, this quoting from Ben van Berkel illustrates the stakes of the implementation of these tools in the architectural production that are here Jakob + MacFarlane and Ateliers Jean Nouvel. The two retained agencies, based in Paris, differ by their theoretical approach towards the digital tools and by the use of these tools. If Dominique Jakob and Brendan McFarlane are well known for their posted interest to the new digital tools in design and manufacturing (Jakob and McFarlane, 2006, 2007; Delaveau *et alii*, 2009), it does not seem to be the same for Jean Nouvel.

This paper will be an opportunity to specifically and thoroughly examine the influences of the digital over architectural conception in the process. First of all, we will present the context of this research. In a

second part, we will focus on the role played by digital tools in operations of conception. At last, we will analyse how designers refer to digital in conception.

## Context of the study

This article is part of a thesis for a PhD in architecture that aims at analyzing the relationships between the *style* in architecture and what can be called a *digital architecture*. We solicit that these new tools modify the practice; the latter can be the subject of a stylization.

Two fields of research in architecture allow me to build the concept of style. It concerns architecturology, practiced at the laboratory Ariam-Larea at the ENSA-Paris La Villette, and morphology, as practiced at the laboratory LAF at the ENSA-Lyon.

Architecturology takes an interest in the conception of architecture and aims to make it describable and understandable by proposing a system of *a priori* concepts. As this discipline focuses on the cognitive operations, we will use the term 'conception' instead of 'design'. This discipline is composed of a fundamental language, developed by Philippe Boudon (1999, 2000) since the 70s, and an applied methodology, developed by Caroline Lecourtois (2009).

Morphology, as Bernard Duprat and Michel Paulin have practiced at the LAF, has interest in the configuration of architectural objects. Through some methods of classification and comparisons based on targeted perception, morphology leads to the constitution of homogenous classes of objects: it observes phenomena of shapes.

Two case studies come to complete and provide examples to our theoretical work of conceptualization. Through some case studies, we understand the analysis of architectural and discursive production of architectural agencies. The methods of analysis used so far are the one developed by architecturology: architecturological analyses of the conception of some projects, nurtured by reference studies and half lead interviews with the designers.

The case studies that we have covered in depth have allowed us to model the design process of projects, thanks to the conceptual tools of architecturology; the references cited and the specific uses of digital tools have been examined in particular. Beyond a simple reference search, our interest has been well targeted in fact on a *modus operandi* typical of each project (and each agency).

If our thesis work relies on these case studies, its aims are not all encompassing only for the detailed analysis of the proceedings relative to each agency. Trustworthy to the scientific aim of the architecturology, « rendre communicable la conception par la constitution d'un langage qui permette d'en parler » (Boudon *et alii*, 2000), this work drifts to build new concepts at one (as the *style*) and the same time digital acceptations of architecturological concepts. In the second case, it is really the need to understand the operational specificities of the digital architectural design.

This paper will be the opportunity to present a few assumptions of concepts, which have been formulated during and through the analyses of the projects from Ateliers Jean Nouvel and Jakob+MacFarlane.

Answering to the question: "how the digital in a large meaning act in the design?" this assumption can be consolidated in two axes, for which the interaction is to be questioned.

1. Digital could invest the architectural conception through the mean of operations.
2. Digital could work as a reference in the architectural conception.

## On the side of the design operations

The expression *design operation* (Henceforth the use of terms in *italic* will indicate the architecturological concepts) is in fact a concept that declines from the architecturological language. It refers to the operations that intent to provide some measurement (in a large meaning) at the object conceived by the architect, object called *model* (Boudon *et alii*, 2000). The

*model* is measured according to different *relevancies*, using a *scale*, central concept of the architecture. The *architecturological scale* can so far be considered as an *operator* calling for diverse *relevancies*. The *architecturological scale* can interfere on the *model* according to three different ways: by *reference*, operation which content will be more extensively detailed in the following part, by *segmentation* (on which will be provided some degree) and by the *dimensioning* (assignment of the *measurement*).

As we can see it, the definitions of these *design operations* do not refer to the digital tool. One of the key goals of our thesis is to integrate the digital dimension to these concepts – even if it entails to build some acceptations – while keeping in memory the principle of parsimony as described by William of Ockham.

In this part, we shall focus first on the *operations of dimensioning and segmentation*. Keeping in mind that from our starting assumption (the use of digital tools is modifying the conception), we can elaborate *a priori* that the possibilities opened by the digital may directly affect the *operations of dimensioning and segmentation*. More specifically, the tools can apply not only to the same operations than an architect, but also to others that their complexity make unreachable. In this case it is possible to talk about *digital operations of dimensioning and segmentation*.

Two examples from Ateliers Jean Nouvel can illustrate our subject. The first project is a tower for housing, located in Chelsea (New York). In this case, the conception of the *façade* has drawn our attention. According to the press release, ([www.jeannouvel.com](http://www.jeannouvel.com)) this *façade* is a “gently curving, glittering mosaic of nearly 1,700 different-sized panes of colorless glass, each set at a unique angle and torque”.

According to Raphaël Renard (responsible for the 3D cell at Ateliers Jean Nouvel), during a half lead interview in May 2008, “the wished effect of sparkling was obtained by the use of random, similar to a painting from Mondrian”. This work of composition was completed by hand: the computer was only used to represent and therefore had only simulated

the intention of the conceiver. Meanwhile Renard explains that if they had the appropriate know-how they would have written a script generating the random composition of the glass panels.

In this example, an *operation of segmentation* (the choice on what the *measurement* will be assigned) and an *operation of dimensioning* (assignment of the *measurement*) are recognizable: the *segmentation* relates to the *façade* (relatively to the rest of the building), and more precisely to the glass panels, while the *dimensioning* deals with the size and the orientation of each panel. The two operations have been completed by a conceiver; if we refer to the words of Renard, the *operation of dimensioning* could have been digitalized. This case well illustrates the possible use of the modeler to replace the conceiver, as straightforward tool for the conception. In this case, the role the computer can play is still relatively narrow.

The second example of the agency relates to a museum in Doha, whose shape deals from an enshrining of discs. In April 2008, we have attended several steps of the conception. Toshihiro Kubota, partner from Ateliers Jean Nouvel, has shown us how the discs had been tangled up: after having modeled using Rhino the curve of the sewing of a tennis ball, he has utilized it as a rail on which the objects (here the discs) have been disposed by the ArrayCrv tool. At last, the positions of each object have been hand modified, so that “it gives a random effect”, according to Kubota. In this example, the digital tool has been involved in the *dimensioning operation* in order to save time: in fact, all these operations could have been hand made, but would have request a much longer time.

A project by the agency Jakob+MacFarlane offers another example of this type, but at a higher level of investment. It relates to the project Blown Data House, achieved in 2007-2008. Called for the design of a « salon » for the Institut Français d'Architecture, Dominique Jakob and Brendan MacFarlane choose to use some meteorological data of a location and translate them into a group of “bricks” that will dress

a structure. In this case and according to the words of the conceivers (Jakob and McFarlane, 2008), the digital tool transforms a script into a graph, and then produces a “brick” by fritting. The ‘human actors’ have intervened at the beginning (writing of the script), then have supervised the unfolding of the process and then finally determined the “bricks” on the structure. In comparison to the building in Chelsea, it is interesting to note here the increase of the use of the computer in the conception/completion process, although still considered as simple executing agent.

What characterizes the three cases is the role that the digital tool plays in the architectural conception process. The tasks are extremely well framed by the conceiver and the results generated by the tools constitute some intermediates steps only. At a level of architecturological interpretation, we really deal in the three cases with the completion of *dimensioning* and *segmentation operations* (or that could be completed) with the digital tool. In the third case, the meteorological data could not be treated without the computer, due to the complexity of the calculation steps. These operations can therefore be qualified as digital.

Until now, we have seen that this last role has been considered as ‘executing’ and that its task was under control of the conceiver. Another project of Ateliers Jean Nouvel presents a very interesting case of induction from the computer. It deals with a housing tower, in the conception phase, located in New York on the same plot as the Museum of Modern Art. For this project, the conceivers have referred from the very beginning to the work of Hugh Ferriss. This architect interested himself at the early 20th century to the “maximum City”, that is the buildings utilizing the maximum volume authorized by the rules of urbanism.

The conceivers of Ateliers Jean Nouvel have therefore used the principle of maximum occupation from Ferriss. After having represented the plot under Rhino, they have applied an extrusion to it. The obtained volume was out of the authorized template.

Then, by a play of additions and subtractions, they modified this volume, on purpose to satisfy the rules of urbanism of the City of New York. The geometry of the obtained volume is then rather intricate. The team utilizing two softwares to work (Rhino for modeling, 3D Studio for the delivering of the pictures), a mesh was necessary to move from one to another. The stitch of this mesh was very basic and based on triangles, according to Renard. Viewing the picture in 3D Studio – that is meshed – Nouvel would have decided that the drawing of the structure would be traced on the mesh.

In this case, it is easily understood that the mesh generated by the modeler has induced the drawing of the structure. Nouvel has reinterpreted in a structural principle the principle of economy that the computer has used to represent the complex shape. The computer has played not only the role of tool but also of induction, thanks to the mediation of Nouvel.

This reinterpretation can be read in architecturology as the label of an *operation of conception* that would come from the *semantic scale* according to Philippe Boudon: the modification of the capture – from a picture representing the volume meshed to a picture representing the structure of the volume.

This *operation of conception* results from the joint activities of the conceiver and the digital tool; the triangulation reaches its operative dimension due to the intervention of Nouvel. And this last one was only possible by the picture generated by the screen. It is indeed this conjunction that allows the qualification of this *digital operation of conception*.

We have seen that this *operation of conception* is extremely precise and consists in a reinterpretation. In architecturology, this concept of *scaleme* defines « la modalité suivant laquelle l'échelle opère la mesure » (Boudon *et alii*, 2000; Lecourtois and Guéna, 2009). In this case, ‘to re interpret the picture’ is therefore a *scaleme*, which refers to a *semantic scale*, according to Philippe Boudon.

On the other hand, we have not precise pursued the nature of this operation. It can deal with

an *operation of segmentation*, (choice of the entity to measure), as the attention of Nouvel stops on the edges of the triangles and make them the edges of the structure. But it can also deal with an *operation of reference*. This last type of operation consists in selecting a *space of reference* to provide the *measurement* to the *model*. The question of the *reference* will now be the subject of this second part.

## On the side of the reference

To start, remember the second assumption that we have formulated above: "Digital could work as a reference in the architectural conception."

Let us examine now the way references are founded in the architectural conception, on the point of view of the architecturology. It seems important to present in first stage the concept of *space of reference* which means « une classe de représentation de la réalité ». (Boudon *et alii*, 2000). In other words the conceiver finds and or builds some representations of the reality that he requests in his conception process. It is easily understood that the references employed can be of diverse natures. Without attempting to make an exhaustive list of the types of references built and used by the conceiver, we can at least distinguish, in the line of Roman Jakobson (1963) and Philippe Boudon (2000), the metaphoric references of the metonymic references. The distinction cannot be summarized to the opposition between abstract and concrete, but deals with the relations maintained between the *referent* and the *model*. As a metaphor, that Jakobson makes correspond to the paradigmatic axis, we define in the first case a relationship of non spatial continuity between the referent and the model: there is transfer of analogical order between the two. As a metonymy, that Jakobson makes correspond to the syntagmatic axis, we define a relationship of spatial continuity between the referent and the model.

We suppose that the 'digital culture' considerably permeates our mode of being and doing; due to this permeation, the conceiver is brought to

refer themselves in a more or less conscious manner. It seems therefore straightforward to speak of *space of digital reference*.

How this space interacts in architectural conception? We have observed in our case studies some examples illustrating the metonymic and metaphoric references.

Two projects of diverse natures conceived by Ateliers Jean Nouvel come here to play as examples: it deals with the Agbar tower and the connection CEVA. The Agbar tower is located in Barcelona (Spain). Delivered in July 2005, it comprises some offices and an auditorium. The information dealing with the conception have been obtained during a half lead interview with Andrés Souza Blanes, project manager at Ateliers Jean Nouvel, as well as during a conference of Nouvel at the Pavillon de l'Arsenal. ([www.pavillon-arsenal.com/videosenligne/collection-4-73.php](http://www.pavillon-arsenal.com/videosenligne/collection-4-73.php)).

The word CEVA is the acronym of Cornavin-Eaux Vives-Annemasse. It deals with a new railway connection between Geneva and the periphery for which Ateliers Jean Nouvel have conceived the stations. This project is in progress. We have based our analysis on the architectural notice written by Ateliers Jean Nouvel ([http://195.15.24.5/CEVA/menu/gares\\_stations\\_ceve/le\\_concept\\_architectural](http://195.15.24.5/CEVA/menu/gares_stations_ceve/le_concept_architectural)).

These extremely different projects share nevertheless a common reference: the "pixel". The architecturological analysis of the conception of the projects has allowed us to understand the operative dimension of this word and its derived meanings (such as "pixelization"). This reference seems to have acted on a metaphoric as on a metonymic way.

Let us start by the relationship to the first type: as we have seen above, the metaphor defines the relations of displacement by analogy. According to Marc Bonhomme (*in* Charaudeau *et alii*, 2002), the metaphor is characterized by the « télescopage de domaines sémantiques différents » and by « une intersection analogique entre les domaines étrangers concernés, cette intersection s'accompagnant d'une modification dans le contenu sémantique »: in other

words, by saying “my sister is a walking Encyclopedia”, we link two different fields (sister / Encyclopedia), we select in each field some properties and we set aside others (my sister has as much knowledge as an Encyclopedia, but the resemblance stops there).

In the two cited projects, we clearly note that the word “pixel” creates a telescoping between digital and architecture. On one hand, the intersection between these two domains is of formal type (the square shape of a pixel). On the other hand the conceiver using the word “pixel” in his conception speech, can be considered as operational. These two points can be listened in architecturology as a *scale of model* and a *semantic scale*: in the first case, it is the form of the referent, which is re-utilized and dimensioned (as the pixel has no fixed size). In the second case, Jean Nouvel assesses the meaning of the term, when he speaks in particular of “pixelization”. According to Souza Blanes, the conceiver wants to recreate a “pixelization” effect on the façade of the Agbar tower: from a close look of the tower, only the “pixels” which recover the tower are visible, while from the distance, the tower appears as a colored picture whose “pixels” are not distinguishable. This game is the mark of the *optical scale*. The same optical game is perceptibly found for the project CEVA, although in this case it is the fragmentation of the light in this transparent “pixel” that creates the interest of Jean Nouvel.

At last and concerning metaphor, Bonhomme (*in Charaudeau et alii, 2002*) evokes a « modification dans le contenu sémantique »: in architecturology, we could speak of a change of pertinence. In the case of metamorphosis from a pixel into a window, it is easily understood that some functional pertinences have been added. According to Bonhomme (*in Charaudeau et alii, 2002*), three functions are attributed to the metaphor: an esthetic function, a knowledge function and a conviction function. In the case of these two projects, it comes easily to the mind that the first function is concerned.

Let us speak now on metonymy: Bonhomme (*in Charaudeau et alii, 2002*) defines it from the linguistic

standpoint as « les opérations rhétoriques touchant la combinatoire des termes au sein des énoncés ». Philippe Boudon (2000) assimilates it to an operation of substitution of the terms within the syntagmatic axis, recapturing here to his point the reconciliation previously completed by Jakobson (1963).

The metonymy is subtler in the case of the Agbar tower: the element “window” becomes “façade”, in the sense where the external layer is integrally made by the windows. The relation façade-window can be understood as a syntagmatic axis. In this project, the metonymy is not digital as the window can recover other forms without modifying the syntagmatic relation. Too, the meaning “pixel” does not intervene in this axis. Thus we could bring together this façade to the one of the Chelsea building, project for which no reference to the “pixel” has been established.

Nevertheless, the syntagmatic axis that we have perceived here seems to be of the same order as the relation picture-pixel. In this case, it is possible to create a substitution between the façade and the image or between the window and the pixel.

If the fact of playing with the perception of the visitor is frequent in architecture, the innovation of Nouvel remains in his *reference* to the “pixel”, and thus to what we have called a *space of digital reference*. Nevertheless it must be precised that for the Agbar tower, the staging of the pixelization is not, according to Nouvel, only a plastic effort. Thus, during the conference given at the Pavillon de l’Arsenal, the conceiver has specified that he wanted to pay homage to Gaudí: « Cet homme, qui a marqué à ce point cette ville, au début du siècle dernier, en reprenant des thèmes qui appartenaient à l’architecture locale, mais en développant aussi tout un art nouveau qui était aussi européen, à travers une énorme invention, et à travers un jeu sur la lumière mais aussi sur les couleurs, à travers une sorte de pixelisation des couleurs faite à partir des carreaux cassés. »

The example of the Agbar tower is particularly complex, so much it is difficult to distinguish the metaphor from the metonymy, but also to clearly surround the operations of conception at work in

this project. But it is this complexity that makes it even more interesting.

When presenting the two agencies, we have insisted on the belonging of Jakob+MacFarlane to the generation of architects using a computer for design and completion. The architecturological analyses that we have lead on a number of their projects have allowed revealing the existence of *operations of segmentation* and *dimensioning* completed by the digital tool. (Delaveau *et alii*, 2009). It seems thus relevant to seek the trace of *operation of reference* putting into games some *spaces of digital reference*.

To illustrate our words, we shall take a project dating from the year 2003, not built and to be located in Propriano in Corsica: it is the house H. The reference work completed to lead the architecturological study is rather lean; in addition, despite our efforts, we could not interview directly the conceivers, as opposed to the other case study.

Let us examine now the main *spaces of reference* in play: in the case of the house H, Jakob and MacFarlane explain after having modeled on the computer the topography of the site, having duplicated the mesh obtained. The two architects then confront the programmatic elements and the two meshes, while being very discrete on the terms of this confrontation. The only explanations obtained (Jakob *et alii*, 2006) remain hermetic, as an example: "Elements of programme were then introduced between the two virtual surfaces. We then let these two layers seep into one another and deform like living shapes appropriating their environment. The result is a series of cellular spaces appearing on a surface guided by a 3D matrix of the topography".

We remain rather embarrassed to accurately model the *digital operations of conception*, in particular the real part of the digital tools. Nevertheless, we can at least identify the *spaces of reference*: this project, as the conceivers present it, can be understood as the results of a game between a program and a site. Two *spaces of reference* initiate therefore in parallel the project, the *space of functional reference* (the

segmentation of the program in "cellular space") and the *space of geographical reference* (the modeling of the topography of the site). We realize quite well the operational difference of these *spaces of reference*: in the first case, we can identify a functional *segmentation* completed by the architects, putting into a play a *semantic scale*: each cell carries a specific name citing a function (Jakob *et alii*, 2007). In the second case, we can identify a *reference* to an intrinsic element of the site (is it the entire plot or not?) and a *dimensioning* completed apparently by the digital tool (from the topography to the mesh).

Of which nature is the reference to the site? The topography is intrinsic to the site. To resume the characteristics of the metaphor enounced by Bonhomme (*in* Charaudeau *et alii*, 2002), there is not a « télescopage de domaines sémantiques différents » between the topography and the project. This example is more related to the metonymy, as we observe a contiguous spatial relationship between the topography and the project. On the other hand, we can note a « transfert discursif » between the two elements, accompanied by a slight modification of sense: either by the mesh of the topography, it is the geometrical relevancy that is kept.

This example is not alone in the production of the agency Jakob+MacFarlane. Thus, the refit of the restaurant Georges in 2000, project that provided their fame, is based on the digital modeling of the Centre Georges Pompidou mesh, this mesh thereafter deformed by the different parts of the program (Jakob *et alii*, 2007). One of their last projects, the refurbishing of the Docks of Paris in City of fashion and design, presently under construction, is also based on the deforming on the computer of the structural mesh of the original building (Jakob *et alii*, 2007).

In Jakob+MacFarlane, agency declaring itself as « plongé dans la révolution numérique » ([www.lejournaldelarchitecte.be/xtras.php](http://www.lejournaldelarchitecte.be/xtras.php)), we can therefore update some *operations of conception* that we have qualified as digital, in particular some *segmentation* and some *dimensioning* completed by the computer.

In return, we have observed these conceivers did not seem to call for *spaces of digital references* for the conception of their project.

## Conclusions

Let us come back to the assumption formulated at the beginning.

The examples of Doha and of the house H, among others, have helped us to observe the *segmentation* and the *dimensioning* completed with digital software.

The examples of the reference to the "pixel" for the architectural conception have verified our assumption of *space of digital reference*. The relations of interaction between digital *operations of conception* and *space of digital reference* remain to be asked.

Can we find *digital operations* putting into the play some *spaces of digital references*? In the case of the *segmentation* and the *dimensioning*, we could quite think to a kind of hybridization between Chelsea (the random composition of the façade, susceptible to be completed by the computer) and the Agbar tower (the explicit reference to the "pixel"). In other words, the composition of the façade of the Agbar tower could have been the purpose of *digital segmentation* and *dimensioning*.

Remains the case of the *reference operation*. This step can put into play some *spaces of digital references*, as we have seen for the CEVA project and for the Agbar tower. But is the *digital reference* a synonymous of *reference* to the digital? In other words, can the computer refer itself to a digital culture, in a kind of *mise-en-abyme*?

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