GEOMETRICAL FOLLIES AND/OR ARCHITECTURE

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Introduction

During the last two years I've had the opportunity to share workshops and classes with different groups of students about the objectives of the European Programme:"Continuum, From File To Factory". The second of these objectives pointed out:

- *Enrich the offered architectural design and construction courses with new teaching material, new teaching subjects, new formal aspects, new construction techniques and new teaching and pedagogical strategies.*

One of the means to accomplish this objective was the use of some software specialized in geometry and automation of the process of designing. The observation of this process has been the leitmotif to write the following text.

Design and drawing tools

In my own experience, during my student and professional life, I've used very different devices to draw my architectural designs: pencils, ruling pens, stylographs accompanied by compasses, set squares and other supporting tools like "parallex" or drawing tables, etc.

Each of these objects used to mean new possibilities of doing things easier, so the designer (student or architect) could use at ease large circles, non orthogonal lines, and other different shapes in their projects. There was no difficulty in drawing them, although this didn't assure the same simplicity in building these designs, but this is anther point.

The arrival of CAD software during the 90s was a major change in this process of parallel evolution between tools and design. The paradigm was changed. Scaling, copying, pasting, deleting, etc. became every day's way of drawing and designing.

Limits in shapes and forms seemed to have disappeared. Again the easiness in drawing and designing was not assuring in parallel the same easiness when building. But it had no way back. Today we do not conceive drawing and designing without CAD.

But evolution has not stopped (and it is not going to do), so haven't CAD programmes. Those very simple applications of the 90s have become complex pieces of software that take advantage of Internet to allow design in large groups, sharing drawings, decision and so on.

Parametric design

In this evolution we have arrived at a new paradigm: parametric. Things in drawing and in designing are not any more disconnected, forming a sum of small elements, but everything is connected to the whole. This connection allows the whole design react when a small element is manually changed. These elements that can be changed are called parameters.

As almost always, it has not been architectural design and construction who has led this new approach to design. Car industry needed to design new forms and shapes to accommodate air resistance, elegance and comfort in their vehicles. That meant to use not simple lines but curves and surfaces which were very difficult to draw and construct.

Looking at the traditional way of ship building, splines make their appearance in car industry and thanks to people like Pierre Bezier, parametric equations were developed to draw and, consequently, build those curves and surfaces.

Architecture could not resist the appeal of these shapes and soon forms that reminded us Art Nouveau or Gaudí, became popular among trendy architects. But these shapes had to be drawn a constructed. Irregular and numerous elements had to be fabricated.

Fortunately CAD was not any more alone, and other acronyms became as popular as CAD: CAM, CAD-CAM, CNC, etc. So, CAD software began to integrate modules thought to produce necessary information to be sent to a CNC machine so that elements were produced without difficulty, in spite of its complexity and variability.

Geometrical follies

So, its seems that practically all forms we can imagine can be drawn by CAD software and transferred to a CNC machine and constructed. With these abilities it is not strange that a kind of race to produce most sophisticated or strange architecture has been observed in the start of the new millennium.

Although it is not necessary, justifications about these shapes have been given. An students, obviously, take this trend in their mental equipment and try to use these new tools of design. Parametric design has become familiar to some students. They use Rhino-Grasshopper, AutoCad-Maya, MicroStation-GenerativeComponents, etc. as the "normal" design environment.

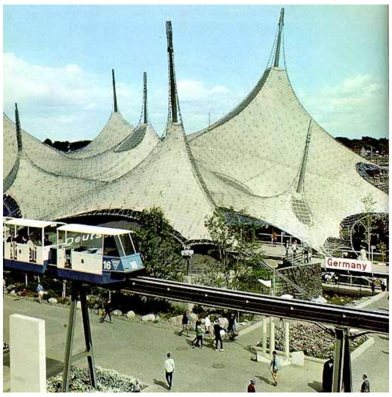
But when design is not any more a process of self decision but the result of combination of different parameters, results may be unexpected, which doesn't mean that they are not interesting. And many times designs result in a process of chance. Designers might loose all control on their designs, so those requirements used in the design (from the Vitruvian requirements to codes, standards, techniques, etc.) could not be dealt as required. Results could becme only geometrical follies and no architecture would be embedded in them.

Tuning

Fortunately these new tools can (and must) be tuned. Young people are used to tuning: motorbikes, cars, computers, etc. and even clothes are tuned. So they understand easily that design tools can be changed or improved so that they work better.

What is tuning in a parametric design software? Scripting!

Parametric design allows us not only generate strange, complex and trendy forms. It allows requirements (any kind of requirements) to govern these parameters, through orders, tests, loops, etc. And this is something that they have to learn if they pretend to drive this tool and not be driven by it.



In my teaching I have had the experience on how to design tensile membranes. At first glance membrane forms remind us other parametric surfaces, so students are easily confused and pretend to generate tensile surfaces as they design other complex surfaces for building façades, for example. Soon they learn that this is not always possible, in fact most of the time it is not possible at all. Tensile surfaces must follow physical rules that are not followed by other surfaces.

So, can they use any parametric software to produce these surfaces? The answer is yes and no.

No if they pretend to use a piece of general software straightforward. Most of popular software is prepared to deal with parametric geometry and the connect to a CNC machine. Parametric geometry has no physical requirement, so shapes that result from this design might be a tensile surface (some of simple ruled surfaces are: hyperbolic paraboloids, for instance), but most probably they will not.

Yes if they can tame the software by introducing these physical rules trough scripting. It is not easy to produce this kind of scripting. Form finding is an important and extensive research field in tensile architecture. Density force is one of the most used method to get these surfaces, but its implementation trough scripting may need the use of matrices, fortunately in linear processes, but anyway tedious programming.

Conclusion

Tools have been and probably will be determinant in the way we design. Students are eager to learn what is happening in our world, and in our design world as well.

What is our duty as teachers about this? Which tools must be allow, propose, encourage to use? Obviously we can not sit and wait that some student shows us what he/she has seen in the "real world": in Internet, in an office where he/she worked during the summer, in a book, etc.

However we must not produce only expert users of software but architects, as we did not produced just draftsmen, when we used those old tools that were mentioned at the beginning of this text. We must accompany them in this process of using new tools, and mostly in making them able to produce their own tools: tune their software.

Of course, scripting is not a natural knowledge of an architect nor of an Architecture teacher. But something must be done. Like other abilities that have emerged in the last years and forced professional educators to recycle, parametric design will change some structures in our education of architecture and some one will have to manage it.

Do not wait for the others to do it!