

Animation to explain Constructive Geometry

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Fig. 1. Palau Güell Chimney Stacks examples

Abstract. Development and widespread deployment of digital technologies, CAD and CAD-CAM systems, have modified not only the way we work but also the way we think. This fact, which is extensive to all design areas, is even truer in some branches, such as architectural design, sparsely identified with industrial production processes. Having a good CAD system, formalization capabilities are almost limitless. In the planning stage we can conceive all sorts of formal solutions in a relatively easy way. But in most cases this free creativity will clash with the reality of traditional production processes that are still predominant in the field of architectural construction. This contradiction is not important for middle-aged architects, still trained within the framework of a traditional culture, but it is important for young people, and especially for students.

Digital culture is fully integrated into the way new generations think. Today young people are used to generating forms very easily by using a few tools from some CAD software. It is not easy for them, though, to accept that those forms must be rethought from a completely different viewpoint, if they want to build. But this different viewpoint, from the constructive geometry, is rarely found on the Internet, where geometry is usually dealt with from its more mathematical side. We must go to some construction old treatises, where these topics are shown by an anachronistic visual language that is difficult to read for people of the 21st Century. In this context, we believe that animation can be a good resource to show how you can carry out a wide range of constructive forms, only helped by a ruler, a set square and some strings; a range of forms we could see, from current viewpoint, as impossible to be conceived and constructed without any digital system.

Gaudi's work is full of formalizations that from current thinking may seem as inexplicable as the Easter Island statues. However, the fact is that

all of them were designed and executed without any of these instruments which seem so essential today. The project we are working on, and the one we want to present to the Conference, aims precisely to show, from a constructive viewpoint and by means of animation, what the geometry that supports the design and construction of several elements of the Gaudi's work is. In particular, we are planning to present a video clip showing the constructive control of geometry of one of the Palau Güell's chimneys. Through the visual capability of the animation, this clip goes to show: how the hat of this chimney is governed by a logarithmic spiral and in which way we can control its construction only by means of a ruler, a set square and some strings.

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1 Introduction

Precedents. Our first contact with animation, not only as an exercise but with the clear intention of putting forward our message was in 1999. The preparation of a programs series about the centenary of the foundation of FC Barcelona [1] took us to take an order from a TV channel to our school. Thinking towards the future, they asked students to draw up an architectural hypothesis about how the club stadium would look like in fifty years' time; that is about 2050. The proposals were to be presented in one of the series programs, and the exhibition format seemed obvious. In a TV channel, especially if it is the most popular and best high-rated channel in the country, rhetoric presentations or graphics with professional looks are not appropriate. We needed a moving images language that, talking about future projections, couldn't be other than animation.



Fig. 2. Frames of FC Barcelona Short Film

Any television channel, obviously, has both professional people and facilities to produce any sort of audiovisual formats, real or animated. However, they understood that the project required some knowledge exceeding their own field of expertise. It required somebody with some knowledge of architecture and architectural geometry and being able to translate to a visual form the expressions – often vague and emotive but not much actual – as students express their proposals. So our position as teachers of architectural representation, specifically

interested in exploring new expression forms arising from the use of computer systems, pointed us as the right team for this task.

Since then, the situation of having the required conditions to carry out the animated explanation of a particular topic has been repeated several times. We did the visual discourse on the geometry of Gaudí "Gaudí. Exploring form"¹, "or the explanation of building systems and architectural elements of Catalan Romanesque churches, or virtual trip to the historical transformation of a territory, or the submission of proposals for the creation or renovation of a neighborhood or the explanation of the basics of Catalan brick vaults, or..."



Fig. 3. Gaudí, Exploring Form Exhibition

All are job orders we have had because our expertise, as architects and teachers, about the concepts they wanted to explain and how to do it in a didactic way. But this expertise was not the only reason why we were the right people to do these jobs. A certain capability to express ourselves in a visual speech by animation was the main reason. Therefore it is because of this combination of factors that we could carry out these experiences.

¹ "Gaudí. Exploring form"[2] the central exhibition of the several cultural manifestations organized in Barcelona because of the "International Gaudí year", in 2002. Conceived as itinerant exhibition, it could be later seen also in León, Genova, Tokyo, Sao Paulo, Napoli, Peking and Shanghai. The exhibition contents can still be seen by means an interactive DVD, published in 2008[3]

Nevertheless we must make clear that we are not professionals in the animation field, we cannot even say that we are experts in it. Our specific area of expertise is architectural representation. And our experiences in the field of animation must be seen as exploring some new expression in this area. Ways in which we feel more and more interested and we are more confident about its potential. However, these ways do not seem to attract much attention among colleagues of our specific knowledge field. We can define ourselves as “frontier people” between two adjacent fields of knowledge perhaps disjoint excessively.

Communicating with Students. For years, our animated works were always motivated by external requests. We were looking for any solution to some communication problems coming from outside. But a few years ago we observed, also in our daily work as teachers, important communication problems. Retaining attention from students for an hour lecture has practically become an unattainable desire, like trying to make them read, carefully enough, any academic text, either a lesson or a simple instruction manual. New student generations have grown into an audiovisual culture, and we can say that they do watch the world through a screen. Our awareness of this fact, among other reasons, has led us to change our lessons model. We do not do theory sessions any longer and we have channelized its contents towards a collection of 50 video tutorials [4] with an average duration between 8 and 10 minutes.



Fig. 3. Students in a working session

In the same work line, we want now to take a new step forward. The present project aims to contribute to finding solutions to a more general problem: the libraries of our schools are losing their readers. Students use the library books only to make some photocopies from their pictures or drawings, but they rarely pay attention to the text, to the narrative or argumentative discourse. In most cases, if the text is not read, those photocopied drawings and images become

nothing but a few graphics without any meaning. A substantial amount of information is lost.

For many teachers, the first reaction is to complain about the apparent lack of interest from students. But complaining does not change anything. We need to find solutions for this problem. The experience of our video-tutorials system demonstrates the interest of the students to acquire knowledge has not diminished at all. What has really changed is the way to connect with these skills. If you succeed in finding the way, students respond and, at least in our case, they respond very well.

We do not believe there is a magical and universal formula to deal with this problem. We think that, right now, what we need is trying new experiences, testing new ways to transmit knowledge to students. Therefore, the project we present aims to be only a contribution to this experimental path.

2 Key Features of the Project

From Communication by Text to the Audiovisual Communication. Geometry and construction processes are subjects traditionally transmitted by means of texts together with some drawings illustrating them. So they are publications where graphics or visual parts already play a key role, because the text cannot be completely understood without the picture. However, in a printed edition, the reading flow is channeled by the text, whereas in an audiovisual this flow becomes governed by the image. The voiceover plays the role of guiding the eye and it complements the image. But voice can pause and “disappear” whereas image cannot. It has a constant presence. If the voice extends his speech, the total time will grow and, therefore, the temporary space to fill with images will grow as well.

We cannot expect that, while the voice is completing a long speech, the reader remains looking at the same static picture or watching some actions or processes having a predictable ending. If it happens, our reader is likely to give up. In contrast to the textual reading, where readers impose the rhythm (they decide when to stop and when to do a quick read), in audiovisual media tempo is already established previously. Thus, image carrying a reasonably strong rhythm will be a required feature, without temporary delays that cause boredom and make our reader disconnect.

We must accept that an audiovisual with these features cannot have the same ability to contain information as a theoretical conventional publication for teaching. This fact, let us face it, is always painful for teachers, because of our natural tendency to more rhetorical speeches. The counterpart lies in the expectations of significant capabilities improvement of connecting with the reader and getting concepts better understood.

Narrative Proposal. All chapters of the collection we are projecting follow the same plot pattern. We report a real architectural element, showing a geometric

structure evident but not trivial. After a description of the chosen item, we explain its main morphological features. Then we expose, from an abstract viewpoint (what we call “digital thought”), the geometric concepts being behind these morphological features. Concepts belonging to the mathematical universe, but that they do not seem to have any direct transcription into the material world, beyond the industrial production environment. Therefore, next step proves this is not true and shows in which way the same shape can be rethought from the tangible world of constructive geometry. Then, we show how that geometrical definition can be controlled, by hand and on site, only helped by instruments that builders of Gaudi’s time could use, as rules, triangle, strings...

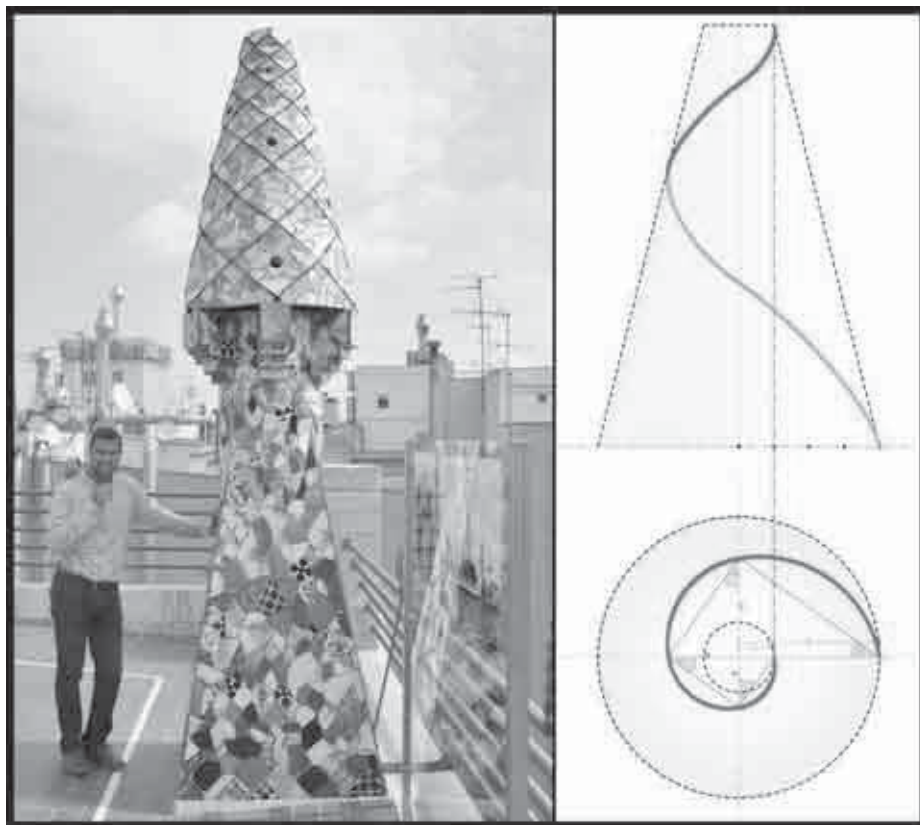


Fig. 4 Fotografia Chimney number 13 and helix projection of a logarithmic spiral

In the specific case of the example we are taking as prototype, the chosen element is chimney number 13 on the flat roof of Palau Guell in Barcelona [5]. When this element is examined in detail, a disconcerting point appears: the surface treatment of its top section is ruled by a helix that is a projection of a logarithmic spiral. As its name suggests, this curve is the graphical expression of a logarithmic function. It has an immediate drawing using CAD systems (just enter

the start and end radii). But, at first appearance, the way to draw this curve on site is not evident. Even if we achieve its drawing with a reasonable effort, obtaining the projection on a cone does not seem an easy thing. So this video clip tries to answer these apparent enigmas.

Dark Points. In brief, this is the plot of the story. But, told like this, this story leaves several dark points. For example, we claimed that this Gaudí's design was ruled by a helix that is a projection of a logarithmic spiral [6]. Obviously this statement must be argued, because we are into an academic context and, therefore, unreasoned statements cannot be admitted.

The point to be discussed then is: how much extension and depth we must give to argue these dark points? As teachers, we can consider very interesting making a comprehensive explanation of arguments. But we must consider the aforementioned limitations of this media, and be aware that excessive scholarship can easily ruin our global discourse. How to get out of this dilemma?

Browsing Reading. In our project, animating audiovisual is the main component, but it is not the only one. By means of these clips we will try to capture the reader's interest on a set of chosen subjects, but without any intention to make an exhaustive discourse. The voiceover and images should refer to those aspects which we called dark points. So, readers can see that there is a statement without being argued, but also without being hidden.

If the clip captures the readers' interest, we expect them to want to increase their knowledge about the subject. And here, in this second level of information, keeping audiovisual support is no longer needed. Now the matter is providing some easy access towards the answers to the questions that the clip has left opened.

So, our idea is that a set of links are joined with the video clip. These links will lead to complementary pages where, already in a conventional form (text and graphics), the arguments will be widely explained. This is a mixed format that, in fact, is matching the model of reading through hypertexts. And we are all used to this model already.

Abstract Geometry and Constructive Geometry. As is clear from all that has been said so far, comparison between abstract geometry and constructive geometry is the common element for all chapters in this collection. We want to get the message that, in Gaudí times and even now, abstract geometry, which is essential for conceiving forms, is not enough to accomplish their construction. To materialize these forms, we should think them again from a different geometry, this is: the constructive geometry.

From one or other viewpoint, the story focuses always around geometry. Therefore some perceptible differences in their look, between both discourses, seem necessary. With this aim, when the explanation refers to concepts of abstract geometry, we adopt a drawing look, cold and neat; however, when the sto-

ry is at the constructive geometry universe, its look is changed to visually express this difference through environment.

Changing looks does not mean giving up abstraction. If we have chosen to operate with animation instead of real video, is only for its capabilities to make abstractions. Keeping the abstract aspect, the change of scenario is expressed by several strategies such as the adoption of perspective viewpoints or the use, in an iconic expression, of some hands and tools masonry (set square, straightedges, pencil, strings, etc.), to try to communicate the manual character of the building processes.

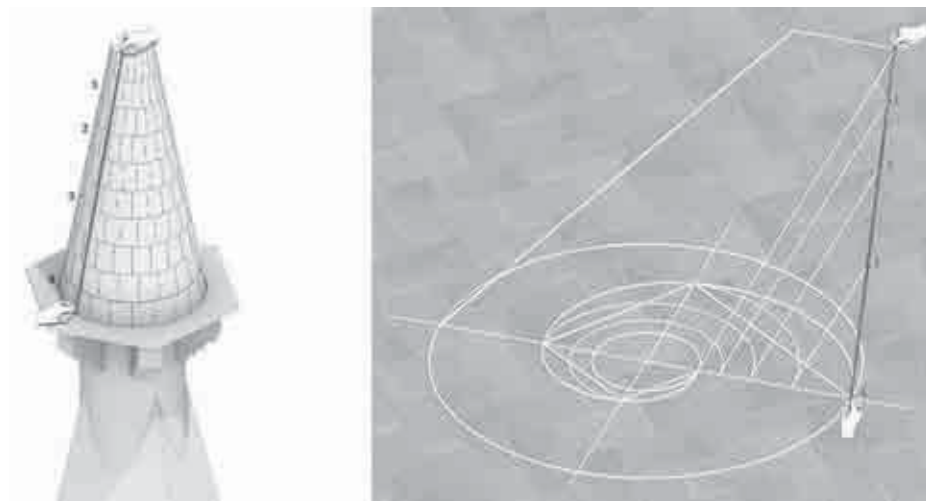


Fig. 5 Visual Expression to communicate the manual character.

3 Conclusions

In the current stage of the project development, there are still many questions to solve. Questions such as, the most appropriate support to contain and run this collection is not decided yet. We think, right now, this support could be any university multimedia website, either as MOOC form or as a multimedia collection for students.

In fact, this is not a question of first importance, right now. Producing some early chapters is now the priority. This will allow us to follow a process of trial and experimentation. A certain amount of experiences, both in production and in reading, will allow us solving several communication issues, which we are aware, and other ones which we still ignore. The reviews, advices and all that can bring us ideas to improve the prototype will be welcome inputs.

It is even possible that, after these experiences, we conclude that this path was not a good solution for the problem we wanted to solve. It is a risk we should accept. What we cannot accept is complaining without looking for answers.

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