

Interventions in the urban setting through generative design and digital fabrication

Three study cases in the city of Montevideo

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In the last few years, much has been written regarding morphological generation through computer-assisted means, algorithm design and digital fabrication. Nonetheless, the purpose of this article is to build, from a social perspective, three different narratives based on three specific study cases in the city of Montevideo. Based upon them, the aim is to reflect on the development of projects at a 1:1 scale in the local university context and its connection with society.

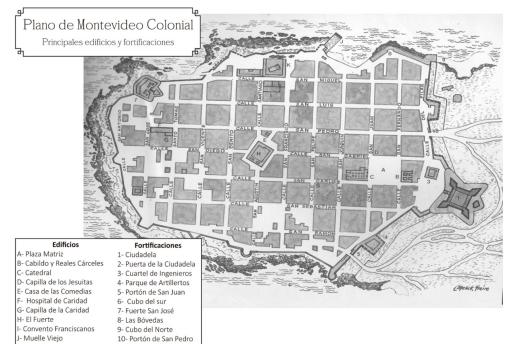
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INTRODUCTION

These three study cases that have been selected refer to the work carried out by the University of the Republic through the FabLab.MVD laboratory, with the collaboration of different colleagues and teachers invited from other universities. Thus, efforts were made to produce a mix based on different conceptions and different visions and ways of approaching reality. In terms of its urban layout and architectural production, the city of Montevideo has a brief history. Founded between 1724 and 1730, it urbanistically refers to a Spanish colonial layout which was subsequently expanded and intervened on, but architecturally nurtured with renovating architecture, where the experimentation of art déco and brick architecture from the 1920s onwards, interspersed with historicist architectures have built an eclectic mix of styles that has been brewing the image of the city. This project refers to three interventions in different points of the city, involving specific actions

of production of the city in terms of projective prosthesis. The projects hereby exposed were carried out with the collaboration of undergraduate students through workshops and seminars on the application of digital fabrication techniques in the urban setting and its impact in the social appreciation of it.

Figure 1
Map of the city.



METHODOLOGY

Among the learning tasks of the undergraduate students of the School of Architecture, Design and Urbanism of the University of the Republic, workshops and seminars were conducted to foster reflection and the creation of interventions in the urban setting, especially in socially recognized buildings both for their architectural value and for their importance in the historical development of the city.

The premise of the three study cases was the use of parametric design tools (Rhinoceros + Grasshopper), the creation of algorithms connecting the shape of the pre-existent building to the target shape, and its production through digital fabrication techniques. The three cases were studied and designed in the classroom, produced in the laboratory, and subsequently assembled on site.

Case 1. The urban symbiont

The Ciudad Vieja of Montevideo is the name of the old center of the original layout of the city. There, the most emblematic buildings of the neoclassic period are located, among which the Misiones building, work of German architect Karl Tramabauer, stands out.

This building, considered architectural heritage of the city, suffered a collapse in the dome located in the northeast corner, caused by the passage of time and the poor state of preservation. The void generated by the lack of a dome was the excuse for the construction of a new message, adding a tectonic prosthesis to the original project. This prosthesis, in symbiosis with the building of Trambauer, intends to reestablish the original shape through the introduction of a new body. This is, not a parasitical structure but a symbiotic one with the original project, which aims to recover the dialogue between the city, its inhabitants and the intervened building.

The symbiont, as it has been conceived, is an object created from an ideal shape (the original dome), which has undergone different experimental plastic actions. The result is a strange but symbiotic object with parametric genes, created through digital fabrication and handmade assembly.



Figure 2
New dome
installation.

It was developed with Rhinoceros y Grasshopper tools. The process consisted of three phases: first, the development of the theoretical concept and the discussion of the different methodological aspects. This phase focused on the conceptual development of the digital paradigm associated with the problems of the parasitical relationships in order to create ideas between complex generative processes and the parasitical behavior in the pre-existing systems.

Secondly, the testing and selection of the generative system. How to create a shape while setting aside the function and aesthetic variables? The first tests included models of traditional domes which were affected based on a sequence of cross sections. In the repetitive process of shape production, variations were introduced, small alterations in the generative patters in order to slightly interrupt the lineal decrease of the gravitational forces through the cover of the dome. These initial tests turned into a dome shape whose generatrixes move, turn and go backwards according to the variations in the generative pattern. The traditional dome is distorted but the shape is still preserved.

The same formal logic which builds the traditional dome is used to rebuild this new object. The third and last phase was the manufacturing and installation of the device in its place. Finally, the object was placed following the logic of its formal generation. The generatrixes affected for the dome-parasite are the ones that were mechanized and assembled in

order to rebuild the shape. The urban impact of an ephemeral, low-cost object in a recognized building was significant, developing social reactions of different types.

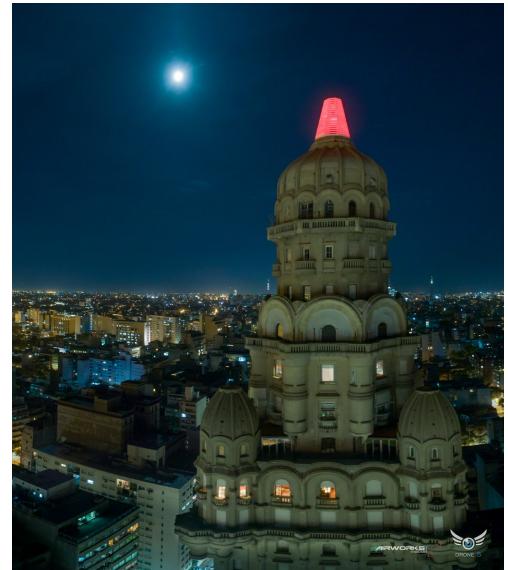
Given the peculiarity of the intervention, an urban attractor was created. Initially, the neighbors showed mixed emotions: from complete acceptance to strong rejection, and all shades in between. However, at the moment of removal, after the stipulated time of permanence, the owner of the building decided to keep it. Furthermore, the inhabitants of the area embraced it as a part of the view, and the market value of the building where it was located had a major increase, despite its low maintenance at the time. Far from this last issue, which departs from the tasks of the exercise, it is of paramount importance to emphasize the significance that a simple gesture of intervention with a strange object in a pre-existing building can have. Perhaps the way of turning a parasitic object into an urban symbiont. This work was conducted with the direct and committed collaboration of architects Federico Lagomarsino, Rodrigo Martín Iglesias, Alejandro Schieda and Santiago Miret.

Case 2. Gran Salvo

Another example of urban intervention that involved digital manufacturing and social interaction. The Palacio Salvo is probably the most typical postcard of the city of Montevideo. Once again, a dismantled shape was the perfect excuse to integrate a designed and digitally produced object in the structure of the building. The place of the collapsed lighthouse was occupied by Gran Salvo, a metallic structure designed in order to replace the original lantern of the dome. Gran Salvo is a large object that combines light and form. The lights are controlled by a Raspberri Pi and people can interact with them, defining the colors, intensity and brightness of the light during the night.

It was also designed to face strong winds and, in the same sense, its morphology follows aerodynamics lines. The old building and the new structure complement each other in a way that creates a new ur-

ban shape in the city. In keeping with the new developments of the IoT, where ordinary objects are connected to the Internet, the intervention also adopts this tendency in an urban scale. The participation of the light as a central element of the project was majorly defined with the support of programmers and engineers and was implemented through a system led by RGB and its respective controllers.



Its handling is versatile and adaptable to different uses, color changes, intensity and production of content, creating a potential hardware to be programmed in different ways and with different func-

Figure 3
Palacio Salvo after
the installation of
the structure. Ph.
Drone5.

Figure 4
Gran Salvo.
Designed by
Federico
Lagomarsino

tions.

The intervention in the Palacio Salvo generated a wide range of perceptions, from the most absolute rejection to the highest praise. In any case, the minority reaction was indifference.

The object was inaugurated with media coverage in all central news. The team who was in charge of the execution, led by the architect Federico Lagomarsino, had to carry out interviews in the media which cooperated to the social debate regarding the meaning of heritage and the willingness to intervene it or leave it just the way it is. Montevideo is a city with little history, but, even so, these kinds of debates enriched the academic scene. Thus, the ethical discussion about the dilemma regarding historical reconstruction or the new intervention arose. Distances and scale aside, this is a controversy similar to the current debate about Notre Dame in Paris. Even without having the controversy being settled, Gran Salvo, created to be an ephemeral intervention, still continues to be positioned in place of the dome of the Palacio Salvo. There it remains, illuminating the city and bonding with its “younger brother”, the Palacio Barolo on the other side of the Río de la Plata, just as its creator Mario Palanti wanted it.

Case 3. Dieste Pavilion

Probably the most ephemeral construction of all the three chosen cases, it was conceived as a sort of homage to the well-known engineer Eladio Diesto by following the spirit of his style and shapes. The design was in charge of the recognized Spanish architect Andrés Martín-Pastor who was a guest teacher from our laboratory for the workshop which brought the Dieste Pavilion to life.

Therefore, the result is an MDF pavilion designed by three developable surfaces that compose a curved shape that evokes the walls and ceilings of Dieste, as in the Church of Cristo Obrero, for example.

Apart from becoming a global trend in several cutting-edge university centers, the execution of pavilions is an opportunity for the construction in 1:1 scale of complex morphologies, capable of conduct-

ing different mathematical notions of descriptive geometry. With this practice, the goal is to convey basic geometry concepts to the students, applying these to the design and to a constructive exercise.

The case study is a light structure, made completely out of wood (MDF). It was proposed as an ephemeral, light, low-cost architecture, capable of being reusable and assembled with general guidelines or even an instructions manual. This architecture is based on the geometric properties of the developable surfaces. The limitation regarding the need to invoke surfaces of revolution results from the choice of manufacturing method, based on the cutting of 4 mm thick sheets of plywood. The prototypes proposed are self-supporting skins made of a single layer of material. Because of the use of parameterization algorithms, it has been possible to implement these complex surfaces in flat pieces that were cut using CAD-CAM technology. These were assembled on the floor like a big puzzle and were then curved cold in the final destination site in order to get their final form and rigidity. This curvature was achieved by its own geometric shape. The proposed system tried to give an architectural response based on the logic of limited material resources (a thin sheet of material) and minimum assembly cost (self-construction), while generating a real production experience in atoms of a digital construction in bits.

Unlike the previous cases, the construction of the Dieste Pavillion was not a prosthetic intervention on a pre-existing building, but an ephemeral construction in itself. As a general concept, regardless of being a shape evocative of Dieste's style, the project served as a 1: 1 scale construction experience in a geometrically complex way and as an example of planning and collaborative execution.

DEBATE

Following this brief summary, some topics emerge, which intend to be the core subject in this paper. In the Latin-American university context, there still exists a collective imagery in which the digital teaching

Figure 5
Dieste Pavilion in
place.



Figure 6
Dieste Pavilion.
Design by Andrés
Martín-Pastor



refers exclusively to the use of representation tools, where there is no room for the projective area. This Albertian ideal focuses on the acts of creation and execution of the project as two different moments, where the latter is a consequence of the former, and both of them are not a unique act of creation.

In the cases presented here, beyond the results obtained, the intention was to generate a reflection on the digital as a design tool, in all its stages. In the context of the fourth industrial revolution, the redefinition of roles in the act of creation forces us to rethink creative structures. Not only from the actors involved in the creation but also from the users of the same.

Mass production is replaced by mass customization, and in that act a change of paradigm occurs where the notion of authorship is diluted and merged in the collaboration of all intervening parties. The understanding of this idea is essential in order to face the act of projecting and executing, seen as a single act of project.

Moreover, the idea of transposing atoms and bits, which is called “physical-digital convergence”, also supports the conception of uniqueness between thinking and doing, as a collective and collaborative reality, where physical reality is only a transposition into atoms of the digitally designed reality.

Finally, and as a final thought, it is important to highlight the social implications of field work in the training of architects. The execution of interventions at a 1:1 scale as an example of how to project must have a parallel as an experimental field, where the urban insertion also has a strong bond with society, generating and building bridges capable of forging at least one part of the identity of the city. In the context of the Latin American city, in particular the city of Montevideo, the intervention in strategic points with actions from the academy serves to forge bonds and bring the work of the university closer to the city's everyday life. This is perhaps the main challenge that must be faced right now.

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