

# Towards a Computerized Physical Architectural Model

## Aldo Rossi and the Theatre of the World

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### Introduction

Recently, museums and cultural institutions propose to visitors a combination of materials: from real pieces of historical and artistic heritage to digital heritage. The artistic heritage is made available through the integration of multiple interactive and multimedia experiences to stimulate involvement and improve user learning. Today, Virtual Reality (VR) and Augmented Reality (AR) are technologies widely used for the conservation, representation and dissemination of Cultural Heritage (Bekele M.K., Champion E., 2019, p.1). They create a digital layer overlapping the real objects, creating contents that may promote knowledge. This contribution intends to examine the question relating to the architectural model as a physical element supporting the values of Cultural Heritage. Something on which to invest, to explore new expressive and communicative potentials in the light of the aforementioned new interactive digital technologies. The way to approach knowledge is more and more digital and made of “on-screen” elements. Can a physical model by a better way to bridge contents thanks to this same digital tools? The first part of the poster will present a report about the solutions that already integrate physical models and digital technologies. The second part will describe the conceptual and practical work ongoing on architecture models at the Architecture Models Laboratory (LMA) with the collaboration of the Extended Realities Laboratory (LXR) at the Dipartimento di Architettura (Architecture Department) at the University of Florence, intending to set the integration of real elements and virtual components based on digital technologies.

### The Material and the Imaginary: on Mixed Reality and Physical Architectural Model

Is there an interface that allows integrating the imaginary, the virtual reality of the immersive experience with the physical reality of the material model? What are the experiences and best practices carried out about it and which are the possible developments?

A first answer may be found in the interaction through a simple application downloaded to a personal device: QR code inserted on a physical model (PM) connected to digital contents; image

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recognition APP to obtaining general and specific information; augmented reality (AR) to superimpose information directly on the PM.

The more complex and articulated interactions are possible thanks to Mixed Reality systems, the use of devices such as AR reading glasses makes the surrounding reality added with digital and sometimes dynamic objects, also reactive to certain gestures. This type of technology was tested by Greg Lynn during the Venice Biennale in 2016, enabling him to propose to visitors a way of acting on the PM by recalling information through gestures and viewing them through the device provided, i.e. Trimble Connect with Hololens. The Arctron 3D company offers combined solutions of VR and AR experience and also of the use of hologram display systems combined with historical models or miniatures of artworks. As part of the teaching about urban and architectural design, the interaction between digital and physical has given rise to a prototype that allows the manipulation of physical objects printed with conductive materials and the consequent visualization on tablets or smartphones of the volumes modified by acting on objects. (Narazani M., Eghtebas, C., Jenney S. L., Mühlhaus, M., 2019). Compliant with the use of Rhinoceros and Grasshopper, Fologram is an AR software to be used with Hololens or directly via tablets and smartphones. It generates contents from superimposing physical reality through AR. It can be hypothesized to use this system as an aid in visualizing the PM before its construction, and as a guide to its construction. In the exhibition area it could be used to understand the construction of the model but also to give information on the project.

Recent events have brought a rethinking about the methods for taking advantage of museum culture. The solutions proposed so far are purely virtual, they exclude the interaction with the physical object. The PM, such as replicas of ancient objects or archaeological finds, could be printed at home or ordered online just to interact with it because it is not possible to replace the physical experience, the possibility of fixing a personalized point of view on the scaled object: this is what makes the PM unique and irreplaceable. The physical model displays the three spatial dimensions simultaneously: as abstract and simplified representation, it shows otherwise unintelligible concepts and principles to the eye. The interactions and augmented experience could then be applied to this PM in a personal way, to be experienced through an application specially designed for that object.

### **Aldo Rossi and the Theatre of the World: Model Making**

Unlike the digital 3d model, the PM is capable of establishing a lasting and stable cognitive relationship in the users looking at it, but precisely the materiality of the PM makes it unable to provide a series of information. In an example: in a PM, matter, context, construction often remains in a state of the generic description. But thanks to the immateriality of digital elaborations the shape of the space acquires further possibilities, the PM needs a simplification of the language of architecture, in favour of better overall readability of the project, but the digital layer may give it back on a different level, not excluding the possibility to imagine, but giving the right information when needed. Attempts to overcome this limit have generated historical examples, first among which are the sixteenth gargantuan models for St. Peter's Basilica in Rome. The AR lays the foundations for a possible overcoming of this limit, giving the possibility of integrating information

about the construction systems in a small size model, to insert it into the context without the need to create large models such as that of the 'basilica that is not there' of Sangallo. (Zander, 2018, p. 4).

The possibility offered by AR is, therefore, the integration between the physical model and digital data, to contain a large amount of information of various kinds on a small scale. The proposed example, Aldo Rossi's Theater of the World<sup>2</sup>, was selected because, like it is for the Sangallo cathedral, it 'does not exist'. The realization of the PM of this little architecture imposes particular difficulties: if externally the metaphysical volumes of which it is composed are easily achievable with multiple technologies (from 3D printing to the more traditional woodworking), the internal construction system consists of an intricate network of thin tubular elements, this complex system, would be very difficult to be represented in a scaled model without creating awkward parts.

Reconstructed using the drawings published by Francesco Fera (2009, pp.128-137), the original 2D drawings were reproduced and subsequently, 3D modelling was carried out through the use of McNeel Rhinoceros and Grasshopper. In this popular plugin based on a visual programming language and environment, a specific script capable of controlling the size of the tubular section of the internal structure has been created to adapt them to the 3D printing types at various scales of representation.<sup>3</sup> It has been noted, however, that even using techniques such as laser sintering, capable of a high level of detail, it is not possible to achieve a perceptually correct conjugation between the section of the structure and the size of the architecture that contains it. To represent the structure, it was decided to start an evaluation on the possible interactions with the AR, to verify if and how the conjugation between the two technologies may fill this gap.



*Fig. 1. 3D print of Teatro del Mondo, material: white PLA.*

Thanks to QR code integration on PM of Teatro del Mondo, digital contents developed during the internship by the students are easily available: more graphic information, a specific bibliography, 3D model for 3D printing, creating an interactive collection that develops over time.

<sup>2</sup> Designed and built by Aldo Rossi for the 1980 Venice Biennale, it was dismantled the year following its inauguration, at the end of his now legendary journey across the Adriatic Sea. The small architecture was then rebuilt in 2004 in Genoa, only to be dismantled again the following year.

<sup>3</sup> 2D drawing and 3D modeling by Enrico Pupi.

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