scholar architect 2022

English edition

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TRANSLATED BY Florina TUFESCU

Editura Universitară „Ion Mincu"
Bucureşti, 2023

This volume is the full translation of **Scholar Architect 2022** (Romanian edition)
ISBN: 978-606-638-247-2
https://doi.org/10.54508/9786066382472
First published 2022 (Romanian edition) by Editura Universitară „Ion Mincu"

Developed within the framework of the **SCHOLAR ARCHITECT** project

"Ion Mincu" University of Architecture and Urban Planning

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DTP, DESIGN AND COVER IMAGE: Ruxandra BALCANU, Anda-Ioana SFINTEȘ

https://doi.org/10.54508/9786066383004

Descrierea CIP a Bibliotecii Naţionale a României
Scholar architect 2022/coord.: Anda-Ioana Sfinteş ; translated by Florina Tufescu. - English ed. - Bucureşti : Editura Universitară "Ion Mincu", 2023
ISBN 978-606-638-300-4

I. Sfinteş, Anda-Ioana (coord.)
II. Tufescu, Florina (trad.)

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378
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editura.uauim.ro / Tel.: 40.21.30.77.193

scholar architect

The Romanian edition was developed within the framework of the project

SCHOLAR ARCHITECT 2022
Research and implementation of new trends, innovations and experiments in architecture and related fields of education
Project financed by CNFIS-FDI-2022-0075

The English edition was translated from Romanian within the framework of the project

SCHOLAR ARCHITECT 2023
Promoting linkage to topical trends, technologies and issues in architectural and urban planning education
Project financed by CNFIS-FDI-2023-F-0436

The Institutional Development Fund, Domain 5:
Improving the quality of teaching, including the observance of professional and academic ethics.

https://doi.org/10.54508/9786066383004.03

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Digital craft in the architectural studio

This chapter deals with how digital fabrication tools and more specifically 3D printing can be included into the architectural educational process so as to complete the studio activity. The emphasis lies on materiality as a result of digital fabrication. We study where exactly, along the didactic process within the architecture studio, digital fabrication can intervene as a study tool.

We have researched how the pedagogical process can incorporate the new digital tools and tested methods of introducing students to new technologies from a critical perspective, thus enabling them to acquire new abilities that will be useful in their future architectural practice. Our aim has been to discover how architectural design can be adapted to the new digital tools, how we as architects can prepare ourselves in order to have an active role in an environment that tends to be oriented towards the digital and how architectural education can include these new tools in the learning process.

Digital fabrication

Digital tools, for both design and fabrication, are increasingly better known and they involve linking the design process to that of materialisation. Digital fabrication is now included in the design process, which takes up both conceptual aspects and aspects connected to the materialisation of a project. In technical terms, digital fabrication entails the production of physical objects using computer-controlled tools.

The focus of interest in current research is on adopting and challenging these digital technologies of materialisation, initially conceived for other purposes, in order to use them creatively in architectural design.

The primary tools with applications in digital fabrication are archaic and essentially similar to those used by craftspeople in traditional manufacturing.

These have been refined over time, changing the way they are set in motion and the method of control. What is new in digital fabrication is that the tool is no longer controlled variably by a human being or repeatedly and precisely by a mechanised system, but variably and precisely by digital means. The movement of the digitally controlled tool is defined by precisely set spatial coordinates, via logical sequences.

Materiality is increasingly enriched by digital characteristics, which have a substantial impact on architecture. In the digital environment, "data and material, programming and construction are interwoven" (Gramazio & Kohler, 2008, p.7). This means that materiality is digitally determined and "evolves through the interplay between digital and material processes in design and construction [...]This synthesis is enabled by the techniques of digital fabrication, which allows the architect to control the manufacturing process through design data" (Gramazio & Kohler, 2008, p. 7). In conclusion, the material is strongly influenced by the digital, it is thus "enriched and [...] becomes 'informed'"(Gramazio & Kohler, 2008, p.7).

Redirecting designers towards materialisation, instead of the creation of a project, an image or a drawing, generates a process which encompasses both design and fabrication. It is no longer about programming constructive systems in the virtual environment, which can be endlessly reconfigured, but about connecting the constructive logic of programming to materialisation (Cache, 2004).

At present, any form can be generated in the tridimensional digital environment and almost any such object can be built. Within this context, digital fabrication has been regarded, until recently, only as the materialisation of digitally generated models. The latest research and contemporary practices start from the fabrication process, which is incorporated into the design already at the concept stage. Thus, the relationship between concept, computation and fabrication is reconfigured, turned into a continuous feedback process, which generates the final object determined by all these parameters.

Perceptions of the digital tool have changed, from a mere executor of standard tasks to a generator of the design process. The capacity of the digital tool to incorporate information which can influence the concept is thereby acknowledged. The tool becomes a creative resource when it provides the designer with the opportunity of using its logic as a generating factor, already from the first stages of the project.

The importance acquired by digital fabrication tools should not be understood as a unidirectional dependence of the object on the mode of materialisation given that digital tools should not limit the design process. These digital tools were not conceived for architectural practice, but they can be adapted to it. The challenge for today's architects is to transform the adopted tools, to use them in the architectural process and to make them their own in their practice. There has always been a connection between architectural and design practice and technological development. Nevertheless, these foreign objects, migrated from different industries and conceived for other processes, have yet to be assimilated and adapted to the creative environment of architecture.

3D printing

Over the last few years, 3D printing technologies have evolved beyond the areas of engineering where they were used to create prototypes or small series of objects with a complex geometry. At present, 3D printing extends to the production of consumer goods, having become highly accessible to the general public.

As a result of concentrating research resources on 3D printing methods, these have evolved considerably. The constantly improving aspects are printing resolution and the quality of the used materials. The performance of the materials used has increased to such an extent that the objects obtained by 3D printing have turned from prototypes into products. The move from rapid prototyping to materialisation has thus occurred.

Architectural education

The proliferation of digital fabrication tools brings up for discussion aspects linked to materials and materiality, which should also be addressed in architectural education. This is why it is important to explore how the pedagogical process can include these fabrication tools as a working instrument in the studio. Students work with bidimensional and tridimensional representations and with physical models. 3D printing can complete the repertoire of tools that students use during the developing of projects in the studio. However, 3D printing should not be simply another means of materialising a model, but should be regarded as a study instrument.

The transition from 3D models to the use of 3D printers should include a few new stages. It is necessary for the students to understand the process and become familiar with fabrication logic. It is important that they should learn to 3D model correctly for fabrication, how to prepare the model for 3D printing, how to generate the code for the printer, to predict what the printing resolution will look like – the thickness of the layer – and how this will influence the final object. They also need to find out the appropriate degree of detailing for the proposal and the scale at which it will be printed for these aspects to contribute to project development. There are also additional, more technical, aspects linked to saving printing time or material, which must be correctly managed. All these constraints linked to the fabrication method should be assumed and included in the project and they are part of the learning process. Only by understanding the fabrication process and its integration in the logic of the object to be materialised can the learning process be improved.

The 3D printed models could be study models from a project in progress, whose purpose is to test the concept. Through this process, especially at the proposal stages of projects, it is possible to produce models with a low level of detail so as to test the concept and its integration in the context – by creating a series of smaller models that can be inserted in turn into the model of the broad context, thus representing different typological or volumetric studies.

Studio 36

In the context of Studio 36, 3D printing was introduced as a study of the typologies proposed within the student group. Here, the produced models were of small dimensions, at the scale of the extended context model. The study aimed at a reading of the varied urban fabric and the proposal of an ensemble of collective dwellings. The result was a series of physical objects embodying this typological study, all generated at the same scale and symbolising the variation of volumetric solutions for a given urban setting.

Studio 36 tutoring team: Melania Dulămea, Ana Maria Vesa Dobre, Dana Anton, Cristian Beșliu

Students: Tamas Barabas, Andreea Bărbuceanu, Dan Chircă, Ioana Davidescu, Andrei Enache, Hoda Enayati, Alexandru Ene, Daniela Firicel, Bianca Hoaghea, Mirona Iancu, Beatrice Milea, Maria Neagu, Teodora Necula, Radu Onea, Andreea Petre, Valentina Popa, Ariana Popescu, Dragoș Punga, Alexandra Radu, Cristiana Roman, Adeline Sandu, George Stanciu, Stelian Șerb, Mara Șerban, Irina Tatomir, Ana Trutulescu, Alice Tulceanu, Sergiu Turlui, Andreea Vlad, Ana Vlaiculescu.

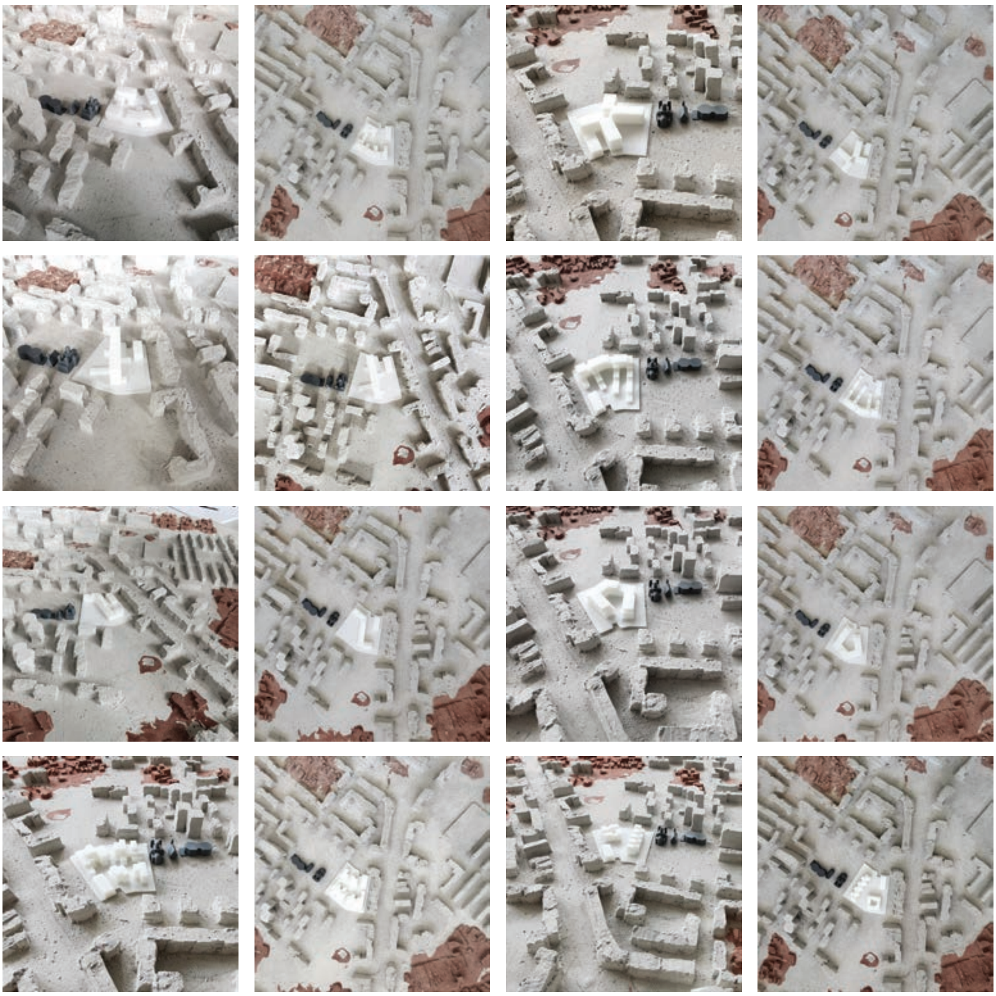
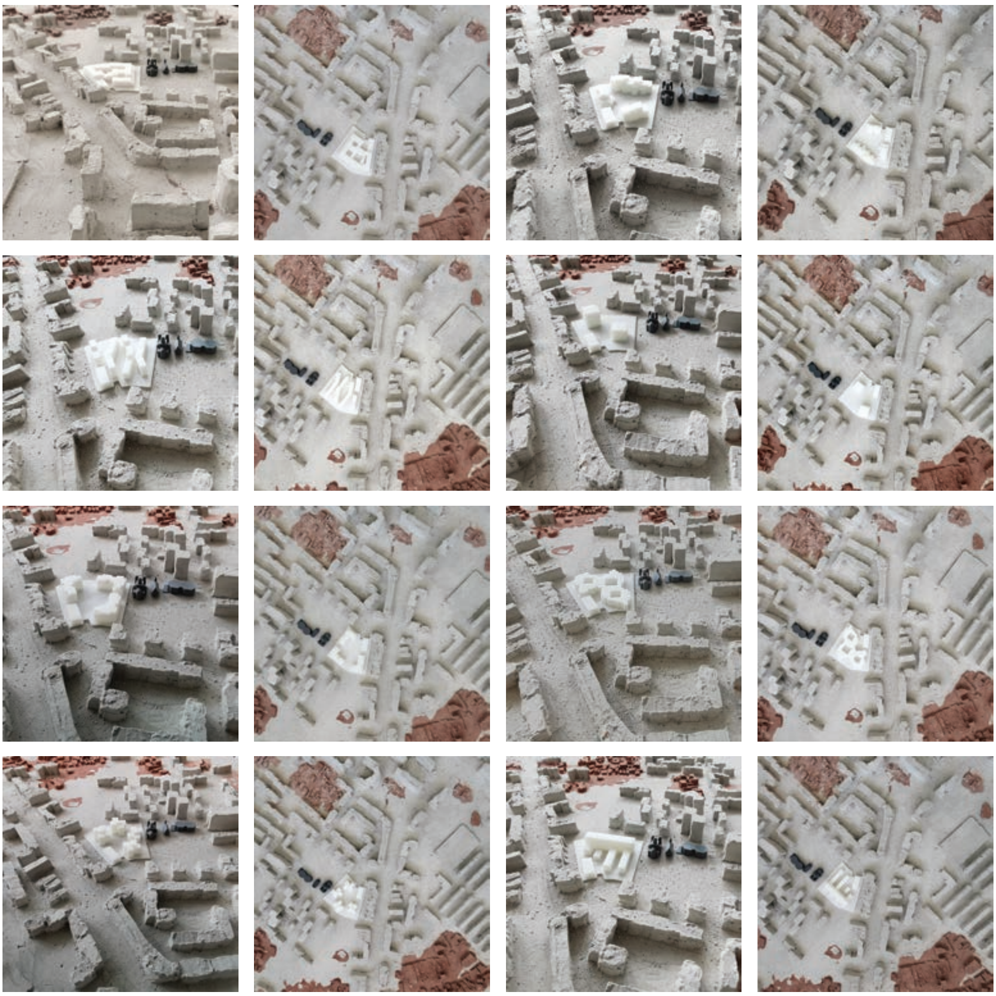


Fig. 1. Image from the exhibition.

Fig. 2. Models created by the students of Studio 36.



Studio 24

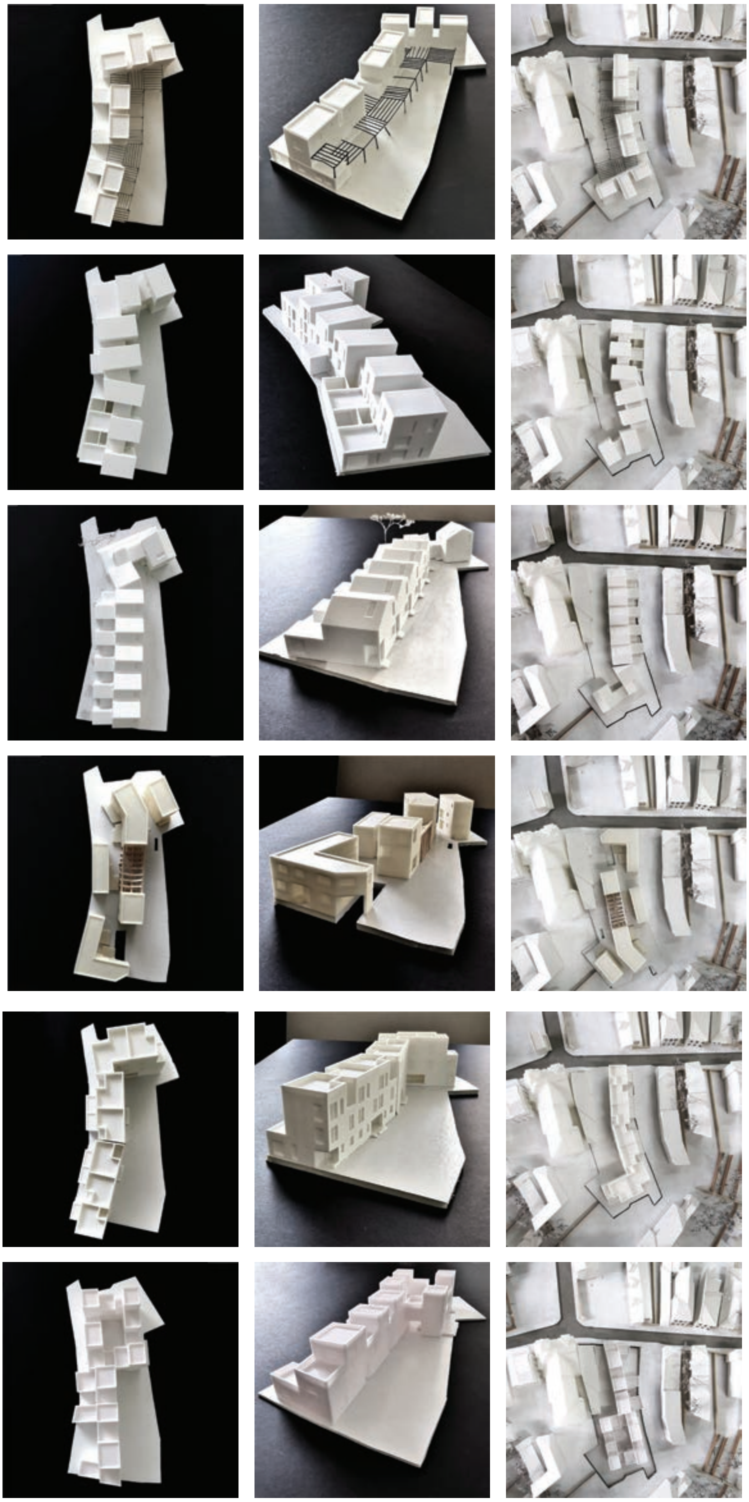


Fig. 3. Models created by the students of Studio 24.

The students of Studio 24 employed 3D printing as a compulsory stage in the use of digital tools, which started from mastering elements of bidimensional drawing and subsequently of tridimensional modelling before covering methods for the materialisation and visualisation of these virtually built spaces. The didactic process involved the presentation of additive manufacturing systems, the actual use of a 3D printer, as well as an iterative series of three-dimensional modelling that simplifies the architectural elements to optimize the geometric resolution to the requirements of 3D printing. Thus, the digital models developed in the course of a studio project were 3D printed as models of architectural objects, in order to illustrate the volumetric and architectural solutions in a coherence of the representation and materialisation technique.

Studio 24 tutoring team: Ionuț Anton, Vlad Nicolescu, Irina Florea

Students: Francesca Barangă, Nicoleta Bordeanu, Alexandra Budașcă, Iuliana Buturugă, Francesca Coman, Alexandra Constantin, Bogdan Costea, Vera Cozea, Carmen Cozma, Miruna Doniga, Cristina Drăghici, Elena Enache, Marina Iancu, Ioana Ionescu, Eliana Lacusta, Maria Marinoiu, Alexandra Matache, Arina Niculescu, Mihnea Oprescu, Bianca Ozkan, Mara Pauliuc, Antonia Roman, Denisa Rotaru, Diane Samaha, Yu Sang, Teodor Sarighioleanu, Ana Sîrbu, Luminița Tumurică, Georgiana Vasile, Andreea Vasile, Tudor Voroniuc.

Fig. 4. Image from the exhibition.

Fig. 5. The posters of the two projects.

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