

Informed Architecture

Marco Hemmerling · Luigi Cocchiarella
Editors

Informed Architecture

Computational Strategies
in Architectural Design

 Springer

Editors

Marco Hemmerling
Computational Design in Architecture,
Faculty of Architecture
Cologne University of Applied Sciences
Cologne
Germany

Luigi Cocchiarella
Department of Architecture and Urban
Studies (DASTU)
Politecnico di Milano
Milan
Italy

and

School of Architecture Urban Planning
Construction Engineering (AUIC)
Politecnico di Milano
Milan
Italy

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Forewords

Rethinking Architectural Education

“Computation is the New Black,” the title of the seminar that has inspired this book, refers to an approach taken by Prof. Marco Hemmerling together with Prof. Luigi Cocchiarella to inquire further into the issue of the implementation of computation and digital technology in architecture, and the present-day education in architecture. The seminar was held at the School of Architecture Urban Planning Construction Engineering (AUC) of the Politecnico di Milano in January 2016, in parallel with an exhibition showing the educational results of two courses focusing on computational design and advanced fabrication, led by Prof. Marco Hemmerling, who was teaching at our School as a visiting professor.

Given the aim of Profs. Hemmerling and Cocchiarella to elucidate the role of digital technologies in architectural education, it is first necessary to define a set of disciplines relevant to this topic, such as architecture and design, representation, mathematics, and geometry. These different disciplines will come together to collaborate in defining tools and the methods of using them in architecture and design.

Our School has become very sensitive to the issue of modernizing education in architecture, in terms of not only tools and strategies but also infrastructure. On the first point, several committees have been at work redesigning our Bachelor’s and Master’s curricula, and the contributions of visiting professors and international experts from all over the world have been increased, in conjunction with a dense program of conference and seminars promoted and held at our headquarters. On the second point, we have started working on a series of projects, together with the rectorate and the departments, focusing on updating and enlarging our technical laboratories, whose contribution is now even more integrated into the daily educational activities.

The experience which students under Prof. Marco Hemmerling have obtained from studies and research is important in testing this topic and has led to a strong debate in our School at the Politecnico di Milano.

Promoting innovation also offers an opportunity to gain benefits from research, which at the Politecnico di Milano involves several engineering and design fields strongly related to architecture. Nowadays, the computational approach offers a common language that can enormously ease and improve the dialog among experts, with positive effects on not only education but also research and professional practice, as well as their interaction.

Considering the international scenario, that is, the multiplicity of backgrounds of the incoming students, and the complexity of the professional areas related to architecture, an important part of the mission of the School is also to provide adequate support for new students in order to ensure that they are sufficiently advanced to profit from attending the programs, and at the same time to enhance targeted traineeships and work experiences as a part of the educational project.

Accordingly, the School organized a group of professors who have the goal and mission to explore in depth the topic of how to derive tools that can be given to our students in order to enhance the new approach, and to investigate how it can contribute to the present-day architecture, to the students, and to society.

March 2017

Ilaria Valente
Dean
School of Architecture Urban Planning
Construction Engineering (AUIC),
Politecnico di Milano
Milan, Italy

Computation is the New Black

This book tackles a key issue for the theory and practice of architecture: the changes in the design process and production due to the irruption of extraordinary innovations in the field of information technology.

The technical possibilities that new information and computational technologies offer design as well as building processes have consequences that are not only technical. Thinking, drawing, and imagining are deeply influenced by techniques that determine new ways of defining things and their relations.

In this book, the introduction of computational methods in architecture and the use of digital architectural representations are analyzed and interpreted not only as new design tools but also as cultural and social challenges.

The example of the success of Building Information Modelling (BIM) can be useful for further considerations. The power of algebraic and geometric computerized algorithms allows us to design buildings in a completely different way from the past. For example, the ability to foresee the building in a three-dimensional space from the outset contrasts with the traditional design process involving initial description through plans and sections (and therefore in two dimensions) and implies what can be called a new “writing” of the architecture. However, BIM is

also a tool for control of the entire project chain, from concept to construction site, within a unified program. It represents a radical revolution for architectural design, which depends on the one hand on the computational power of information technologies and on the other hand on the power of representation of computer graphics programs.

If we consider the importance of tools and instruments in design practices, we should then be able to answer many different questions:

How do specific and concrete design practices happen through the use of these new “tools,” which are still instruments (such as the pencil, the paper, and the drafting machine) but which “write” the world in another way?

What are the reasons why these new tools are being deployed? There are aesthetic reasons, connected with the possibility of generating new and different forms, but in addition crucial economic and organizational reasons have to be taken into account. BIM optimizes the building production process, fully integrating the project activity into construction practices and, through this integration, redefining the social and technical role of the architect.

What consequences will these techniques for design thinking and their outcomes have, based on the way architects and architecture students practice the project, for the necessary innovation in our academic strategies and training programs?

All these serious questions need a profound understanding of the opportunities, challenges, and risks that this revolution will bring in the coming years. This book offers a fresh and articulate representation of these opportunities and challenges, in an interdisciplinary perspective that takes into account both the theoretical issues raised by computational techniques and the economic, social, and cultural dimensions of this reorganization of the entire sequence of architectural production.

March 2017

Gabriele Pasqui
Head
Department of Architecture and Urban Studies (DASTU)
Politecnico di Milano
Milan, Italy

Preface

The future is above all a question of design (Vilém Flusser).

The impact of digital technologies is perceptible on many levels, and since the process of implementation of such technologies is still in progress, it will also determine our future. Predicting the future has always been a dream of man. Nevertheless, it is still the case, perhaps fortunately, that the future remains unpredictable. Over recent years, however, computational tools and methods in architectural design and construction have developed rapidly and now allow for an approximation and simulation of the future in our profession. At the same time, complexity is increasing and the frontiers between the professions are becoming more and more permeable. This is both a big opportunity and a demanding challenge as new concepts and promising solutions can only be achieved by interdisciplinary work, where each field contributes its expertise, methods, and different points of view. Managing this process requires a holistic approach rather than focusing on individual aspects. In other words, we are looking for strategies of integration and a process-oriented perspective in architecture.

Information technology has brought about lasting changes in design and production processes in architecture. At the same time, our demands in respect of design and building processes have increased in line with technical possibilities. Aside from unprecedented geometrical freedom and new fabrication technologies, there is huge potential to optimize functions, energy usage, and performance of constructions, buildings, and services.

The programmatic title “Informed Architecture” connects the different topics and professions involved from a holistic perspective, ranging from Computer-Aided Design to Building Information Modelling, from Programming to Simulation, from Digital Representation to Augmented and Virtual Reality, and from Digital Fabrication to Physical Computation. In this book, experts from these fields contribute their academic and practical experience and their findings in research and advanced applications. The interdisciplinary contributions to this book cover the fields of architecture, engineering, design, and mathematics. In addition to these

scientific papers, documentation of academic projects illustrates architectural case studies that were carried out at the East Westphalia University of Applied Sciences and the Politecnico di Milano. Downloadable interactive digital graphics samples related to the mentioned projects will be included as supplementary information.

Against this background, the publication not only showcases the broad range and impact of information technology in architecture from an academic point of view, but also discusses different teaching methods and future developments in the field.

As such, this book will serve as an inspirational source for students and lecturers in architecture, design, and engineering as well as a state-of-the-art overview for researchers and professionals. Moreover, the volume will contribute to interdisciplinary discourse and aims to foster the critical discussion about the opportunities and risks for our profession in the digital era.

What are the conditions, constraints, and opportunities of this digital turn for the conception and making of Architecture? How do processes change and influence the result? What does it mean for the collaboration and roles of the partners involved? And last but not least: How does academia reflect and shape this development and what will come next? Following the sequence of architectural production—from design to fabrication and construction and the operation of buildings—the publication discusses the impact of computational methods and technologies and their consequences for the education of future architects and designers. Hence, this book aims at an in-depth understanding of the processes involved and reflects them in respect of our technical, historical, social, and cultural environment.

Prospective interested readers of the volume are all those academic and professional operators involved in the above-mentioned fields, including Bachelor's, Master's, and Ph.D. students, to whom this work could be proposed as a textbook, that is, as a theoretical as well as an operational reference.



Milan, Italy
March 2017

Marco Hemmerling
Luigi Cocchiarella

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