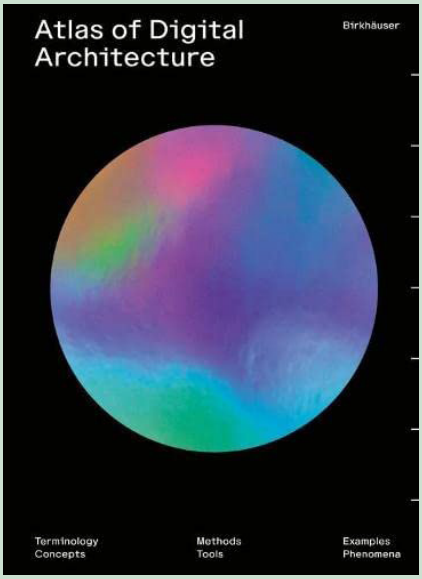
Book Review: Atlas of Digital Architecture: Terminology, Concepts, Methods, Tools, Examples, Phenomena (2020)

Writer: Sebastian Michael
Basel, Switzerland: Birkhäuserr Verlag GmbH; 1st edition.760 p.

Reviewed by:
Prittipoen Lopkerd
Faculty of Architecture and Planning, Thammasat University, Thailand

* Corresponding author e-mail: lpritti@gmail.com
Received: 13 Sep 2022; Revised from: 24 Sep 2022; Accepted: 27 Sep 2022
Print-ISSN: 2228-9135, Electronic-ISSN: 2258-9194, https://doi.org/10.56261/built.v20.247388



Today, the extension of technologies offers methods of computation that have disrupted the limitations of thinking, workflow processes, construction, and resource management from urban to architectural approaches. New approaches and methodologies of digital technology don't just affect the workflows and practices of architects but shape the very character of architecture. With the development of computation, a variety of new methodologies and features have given rise to the role of digital technology in influencing the many stages of architecture processes. In addition, an increased incidence of digital technology has created a paradigm shift in architectural pedagogy and program. Therefore, it is essential to cultivate and practice the skills of creative integration between digital technology knowledge and architectural design.

Atlas of Digital Architecture: Terminology, Concepts, Methods, Tools, Examples, Phenomena

Atlas has published 760 large-format pages and almost as many illustrations that focus on the unlimited possibilities of computers in architectural scope. Two dozen university professors and lecturers share their vast range of expertise with a professional writer (Sebastian Michael) and three editors who are professors

from architectural academies, namely Ludger Hovestadt (Institute for Technology in Architecture, ETH Zürich), Urs Hirschberg (Institute of Architecture and Media (IAM) at Graz University of Technology), and Oliver Fritz (HTWG Konstanz University of Applied Sciences).

Atlas of Digital Architecture presents all conceivable ways architects use digital computation. The content of this book consists of using digital tools and computing processes in terms of concept, meaning, techniques, workflows, and examples of tools and architectural productivity. The overall content explains background, overview, theoretical framework, principle, and particular way of thinking about architecture and computing for each issue with examples of architecture and method of workflow techniques in digital tools. Examples of knowledge and thought tools are: geometry modelling, graphs & graphics, visualization, writing & code, digital manufacturing, big data & machine learning, private & security, collaboration, and the internet of things (IOT).

Book's components

The book is structured into six parts according to the complexity of the content. A chapter starts the book, giving readers a visual means of mentally structuring the book's six sections and two dozen contributions.

The main content of book offers an orientation to the myriad ways in which computers are used in architecture today, such as: 3D Modelling and CAD; Rendering and Visualization; Scripting, Typography, Text & Code; Digital Manufacturing and Model Making; GIS, BIM, Simulation, and Big Data & Machine Learning.

Each of the six parts is organized into several chapters according to the learning sequence, digital technology sophistication, and scale of architectural process. This provides a better understanding of the digital process, as well as the primitive and advanced technology of fundamental digital techniques to practice. Each topic is depicted through a professional profile of examples of paradigmatic works in architecture. Although the pages are large pages with many illustrations, the proportions are clearly divided for easy reference. To increase the flow of text, the images are presented as thumbnails between the text, but there are larger images (this requires a good deal of flipping back and forth between pages). For example, the reader who is interested in 3d modelling can easily find the parts of the book with relevant content, while those who want to learn about code — and learn a little coding in the process — can see where to look.

The first introduction in the book, giving users a visual means of mentally structuring the book's six sections and two dozen contributions. The end of each chapter ends with some thoughts on the future of digital computation in architecture. The Atlas is an array of engaging and episodic chapters, so the best way to study and understand is to find a subject-essay of interest.

Part 1 The Design – Creating the geometries of architectural artefacts

The first part - creating the geometries of architectural artefacts - provides an overview of digital methodologies, tools, and approaches that are available to the architect of today to generate the essence of architectural design. There are six chapters in this part, namely 3D Modelling, Digital Data Acquisition, Digital Design Strategies, Computer Aided Design (CAD), Generative Methods, Graphs & Graphics.

This part introduces the principles of 3D composition, model types, operations, and transformations that make possible the range of geometries available in architecture today.

Digital data acquisition describes the historical methods and process of data collection that work with the existing context and predate digital planning, modelling, and design.

Digital Design Strategies describes concrete strategies for the solution space from the design and performance spaces through three specific examples: architecture as mathematical science, architecture as a performative art, and architecture of the senses. Computer modelling is not only a representation of a finished design but can also be used as part of the design process.

The history and organizational components of computer-aided design (CAD) in 2D, 2.5D, 3D modelling, and the prologue from parametric design to Building Information Modelling (BIM).

Basic concept of generative design, such as: L-systems, shape grammars, and morphogenesis, to create extraordinary geometries with the purpose of finding optimization solutions in terms of creative design and functionality.

And finally the first of several more theoretical chapters to introduce graph theories in computer science to graphics, and from graphics to architectural forms, with an outline of conceptual mathematical principles and coding that encourage digital architecture and a walk through some examples of working with surfaces and forms.

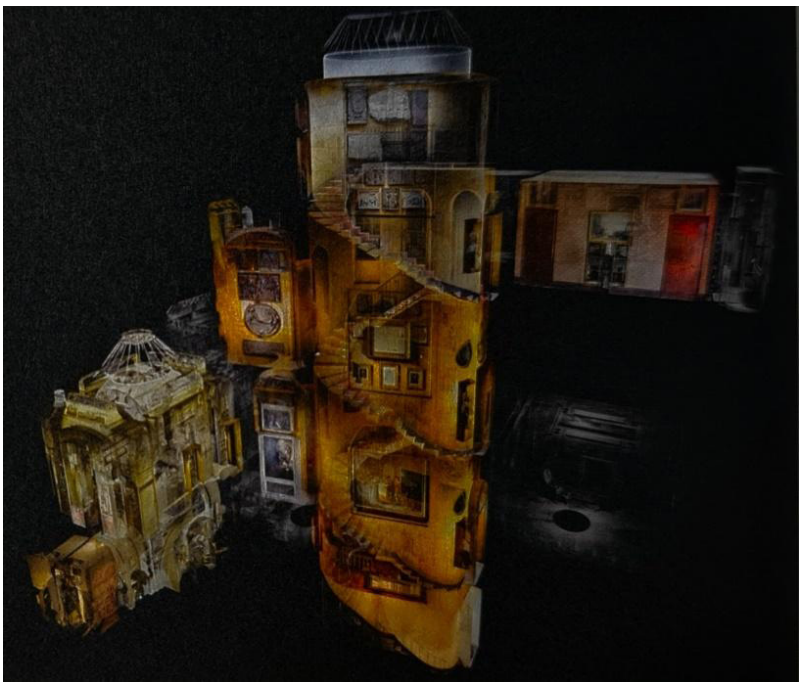


Figure 1 3D scan and data reconstruction of the Sir John Soane Museum. Amuseum Made Digital by ScanLAB Projects (Michael, 2020, p.218)

Figure 2 Visualization of Cologne Cathedral interior, 1856 (Michael, 2020, p.313)

Part 2 The Image

In this section, Atlas charts the history of imagery in computing from its origins and describes the elements, formats, tools, and methods that allow architects to make architecture visible with images effectively on a computer before it is built. It looks at visualizing architecture for representation of designs.

The first chapter of this part describes the history and background of imagery in computing from its origins and describes the elements, formats, tools, and methods that work with quality.

The second chapter discusses rendering as a technological stage that means visualizing or simulating realistic models; in addition, the content includes the main determinants of rendering such as lighting, texture, atmosphere, focus, and style.

The last chapter describes the visualization, especially working with architecture design in an existing context. The visualization has to be convincing as a proposition and a potential reality for communication with people who are decision makers. Two really different approaches to visualization by two architects with different objectives and techniques. The last issue includes two factors that affect the direction of development: virtual language, and one associated with process.

Part 3 Language

This part provides an overview of the abstraction of architecture that is related to the realm of coding, its relationship with semantics, and language. Scripting and Code is becoming increasingly important for architects who want to forge their own style. These have become fundamental to the understanding and practice of architecture in this century.

The first chapter of this part (Text, Typography & Layout) looks further into the origins of data processing and explores the specifics of working with numbers, text, and words, in terms of character encoding formats for text data in computers and creatively deploying typography, be that

for a printing, a presentation, a set of drawings, or as part of the architecture. Additional content defines the terms “cross-media type” and “optical character recognition (OCR)” in brief.

The second chapter of this part describes the background and concept of scripting. Many visual programming languages - the most widely used software, especially Grasshopper - use scripting to enhance the architecture design. The real power lies in understanding the principles of scripting and being able to write our own short programs.

Writing and Coding is the third chapter in this part that introduces an initial digital writing, principle of algorithm, development phases of coding, examples and experiments in coding. In detail, three fundamentally different approaches to programming and computing are discussed: rhetoric, grammar, and dialectic.

In Writing & Code we look in detail at the three principal phases of computer development and at how these can be characterized as three fundamentally different approaches to programming and therefore computing.

Finally, the last part suggests what programming language to learn and further reading for anyone interested in an in-depth understanding of compilations of programming languages.

Part 4 Matter & Logic

The Physical Representation of Architecture: This section consists of physical computing that is relevant to turning our concepts and visual representations into tangible, haptic, three-dimensional objects, and the material reality of making architectural objects with both contemporary and traditional technologies.

The first chapter of this part, ‘Digital Manufacturing’, is focused on Computer Numerical Control (CNC) systems rest at the heart of all digital manufacture, and have become a cornerstone of architectural practice, enabling the production of sophisticated geometries for construction, prototyping, or modelling with otherwise unachievable levels of precision and complexity. The reader will understand the principal methods of the taxonomy of processes in digital manufacturing, such as additive and subtractive processes, including integrated processes (automation and robotics) with a case study of these technologies.

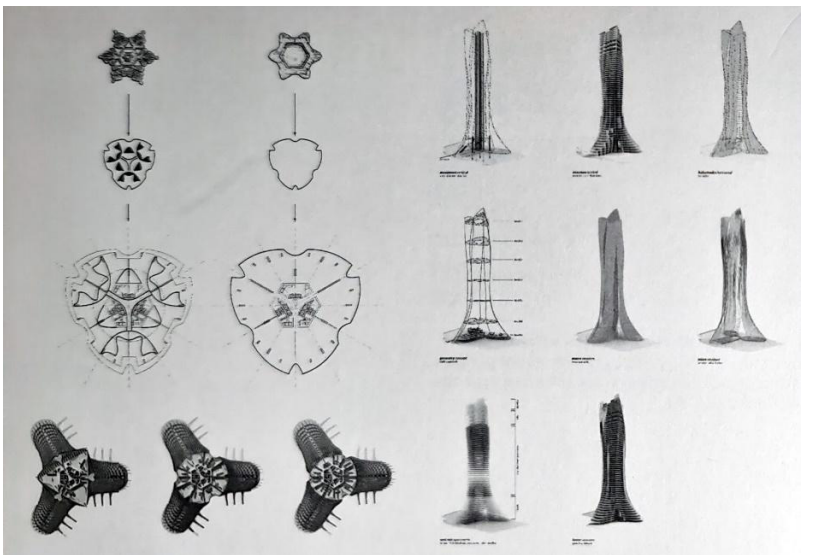


Figure 3 The Snowflake Tower by LAVA is an unbuilt project for Abu Dhabi, inspired by the shape and structure of a snowflake. (Michael, 2020, p.365)

The second chapter of this part, ‘Model Making’, mentions the principles of physical modelling that are capable of immediately communicating complex physical phenomena and relationships concerning the object, its functionality, and its adaptivity to its environment. This topic emphasizes the features of creating a physical model from digital technology, including the interaction relationship between the virtual model and the physical model.

The third chapter of this part, 3D Printing, is a subset of additive digital manufacturing that has become of such importance to architecture. This chapter is about the impactful conceptual paradigm shift that has taken place from traditional types of manufacture to this technology. It introduces 3D printing methods and processes currently in use.

Figure 4 Assembly process of 36 lightweight fibre composite components on site (Michael, 2020, p.455)

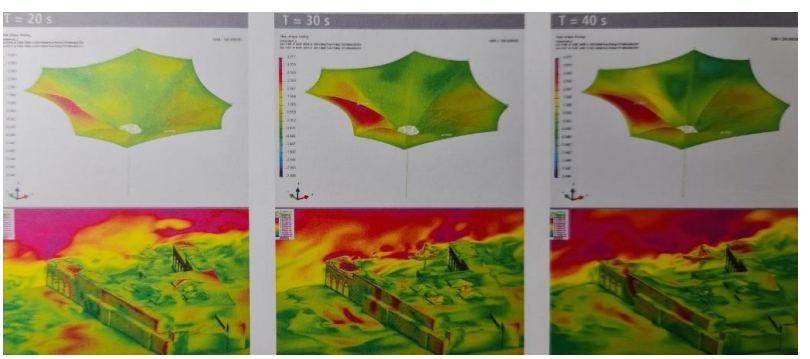


Figure 5 Fluid structure interaction simulation of critical configuration when completely open: analysis of wind – induce oscillations and cut sizes, vertical membrane distortion, and wind speeds (Michael, 2020, p.582)

Part 5 Logistics - The Dynamic Representation of Architecture

This section consists of the discussion of the wide range of digital tools and informational contexts in which architecture is being realized, with six topics: Virtual & Augmented Reality, Simulation, Geographic Information Systems (GIS), Building Information Modelling (BIM), Digital Cities, and Big Data & Machine Learning.

The Virtual Reality (VR) and Augmented Reality (AR) chapter provides a brief history, programming technology, and essential hardware components of VR and AR that have a relationship with architectural storytelling to convey the experience. The direction of AR/VR is concerned with a degree of maturity in realization, stage of interaction, and immersive space as real, which includes the main determinant of success in the future.

The Simulation chapter describes the role and background of digital technology in simulation techniques of all kinds that are central to every aspect of architecture: form finding and design; performance evaluation; project proposition and approval; light, sound, air, and energy flows; emergency and evacuation.

The Geographic Information Systems (GIS) topic, in terms of architectural design, provides an overview of GIS in context and tools, components of a GIS, and examples of possible types of analysis from GIS data.

Building Information Modelling (BIM): significant parts of the construction industry are either seeking or are being encouraged to employ the integrated modelling and management approach that is BIM. This section includes a definition of BIM, semantics, and standards, such as characteristics of the BIM approach, government policy, project execution, lifecycle management, and BIM in architectural practice.

THe Digital Cities chapter presents the city of the future, with digital technology and smart city concepts being put in place to aid space and infrastructure planning, service provision, citizen participation, and the optimization of resources.

Big data and machine learning are the subjects of this chapter which provides an overview of the three phases of the evolution of artificial intelligence and machine learning. Examples of coding are introduced at the end of this chapter.

Part 6 Coexistence

The last part of a book comprises the interfaces and modes of collaboration between information technology and architects.

The first chapter of this section, discusses how to articulate an identity for yourself in a world overrun with visual references and digital data. There are possible scenarios to illustrate a particular approach and demonstrate a methodology and mindset through an encounter with plenty, in two acts: pictures that talk, and texts that draw.

Second chapter of this part, the Internet of Things (IoT), is the topic of computers embedded into objects, such that the state of these objects can be perceived and processed to digitalize anything from cities to buildings to the waddles of penguins. This chapter summaries the underlying technical challenges and introduces some of the solutions available for applications specifically in architecture.

The third chapter discusses concepts in the age of sharing, as well as entirely new ways for people to collaborate across geographical and professional boundaries. With open-source software, makerspaces and platforms for shared approaches, collaborative projects have flourished on the Internet.

Privacy and Security is the complex question of the last chapter. The digital tools and a command of the principles of code can help navigate our way through complex issues and make sense of our world based on the conception of human and civil rights. On the one hand, we can gain significant benefits from giving up our notion of privacy by participating. On the other hand, we are continually exposed to threats to our reputation with hardly any effective legal protection at all. In addition, this enhances a better understanding with examples in conjunction with the introductory texts on privacy and security. There are in-depth examples and experiments in coding that use mathematics and are written for a programmer.

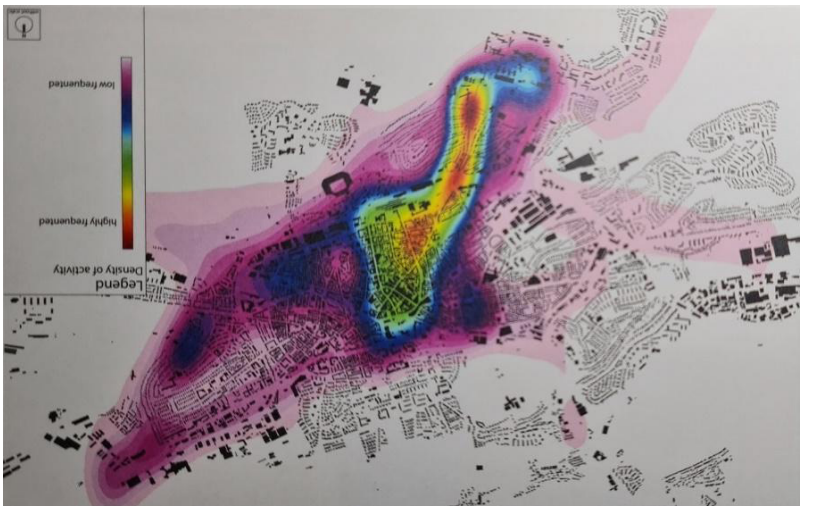


Figure 6 Heatmap showing areas of Kaiserslautern by the researchers and the frequency with which they did so (Michael, 2020, p.588)

Conclusion

In conclusion, this book of Sebastian Michael was written to present a wide range of ideas for a new landscape with opportunities, challenges, and enormous potential for digital technology in architecture. This book is like an atlas or encyclopedia of fundamental digital technology science in all areas of computing that play a vital role in architecture between the past, present, and in the near future. Although Atlas is like an encyclopedia, it is not structured like a traditional dictionary or encyclopedia either.

The summary, in a nutshell, is the phenomenon of digital disruption. For example: each topic has digital tools that affect the process of thinking, analysis, designs, construction, and operation/ maintenance throughout the lifecycle of a building. The result is a turning point in the way of creative thinking in the design and the architecture construction process.

So, this book is easy to read for professional architects who want the opportunity to upskill or reskill knowledge of digital technology for integration with professional practice. Academics, students and future generations of architects should study the main subject of the course in order to design architectures that are based on computation and going beyond the confines of the traditional textbook. In this it postulates a theoretical framework for architecture in the 21st century.

References

Fortmeyer, R., & Linn, C.D. (2014). *Kinetic architecture: Designs for active envelopes*. The Images Publishing Group.

Michael, S. (2020). *Atlas of digital architecture: Terminology, concepts, methods, tools, examples, phenomena* (L. Hovestadt, U. Hirschberg, & O. Fritz, Ed.). Birkhäuserr.

Melendez, F. (2019). *Drawing from the model fundamentals of digital drawing, 3D modeling, and visual programming in architectural design.* John Wiley & Sons.

Reas, C., & McWilliams, C. (2010). *Form+Code in design, art, and architecture*. Princeton Architectural Press.