Book Review: Drawing from the Model: Fundamentals of Digital Drawing, 3D Modeling, and Visual Programming in Architectural Design

Frank Melendez (2019)
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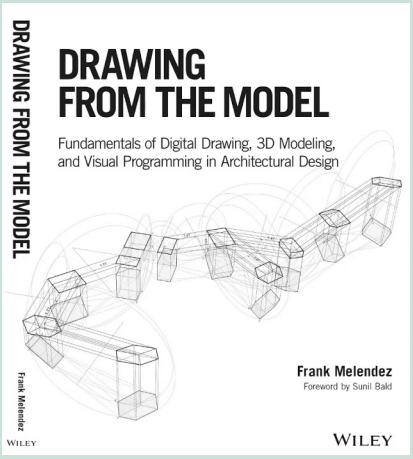
In the past, digital technology did play an important role in architecture industry through design process and architectural construction with digital content constraint under boundary between digital world & analog world (physical or real world). Today, the actually extension of technologies offer the methods of computation that have disrupted the boundary between digital and physical content. The role of digital computation has become the new convention in generating architectural drawing and modeling in both academia and practice. The process of working from digital computation has created a paradigm shift in architectural pedagogy and methods of teaching architectural presentation.



Drawing from the Model: Fundamentals of Digital Drawing, 3D Modeling, and Visual Programming in Architectural Design

This book has published texts that focus on the role of responsive technologies in architectural design and educational pedagogies. The author is Frank Melendez who is an architect and educator practicing in New York City. He is an Assistant Professor at the City College of New York, Bernard and Anne Spitzer School of Architecture.

The content of this book has consisted of the introduction of using digital tools and a computing process for methods of creating architectural design drawing and 3D models in terms of concepts of digital tools, techniques, and workflows for producing architectural design drawings and modeling. The overall content is explaining background, overview, and principle of computation process in each issue with example result of architecture and method of workflow techniques in digital tools. Examples of method techniques are 2D vector based on software Adobe Illustrator, 3d software Rhino and Grasshopper, and physical computing with microcontroller based on Arduino board.

Book's components

The essential content in this book is divided into 4 main parts according to the learning sequence. The main content in each part is gather in several chapters to provide a better understanding of traditional process overview to digital process and primitive and advance technology of fundamental digital techniques to practice respectively. Each topic is described through examples of paradigmatic work of architecture. Each topic is depicted through examples of paradigmatic work of architecture.

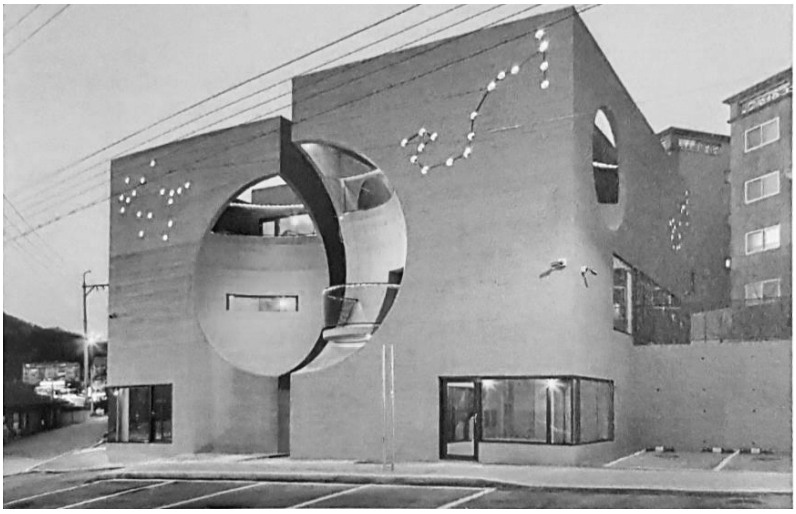


Figure 1. Two Moon (Moon Hoon Architect) is example of Boolean operations of 3D modeling. (**Source:** Melendez, F. 2019, p.103)

Part 1 Architectural Representation and Digital Technologies

This part provides an overview of drawing, modeling, and computing, beginning with historical analog methods, and transitioning from traditional architectural presentation to contemporary digital techniques. A background and concept of use of drawing in architectural design, and descriptions and examples of models that range from physical to virtual models. Additional content includes moving back and forth methods between the physical and digital, such as scanning technology, and digital fabrication. And the last of part introduces an initial digital concept, computing in architecture (about computer-aided design: CAD), simulation models, virtual reality and augmented reality, and development of digital content such as parametric models and building information models (BIM).

Part 2 3D Modeling and Geometry

This section introduces tools, techniques, and workflows for generating fundamental geometries base on Rhino® software which is a foundation for learning more advanced concepts related to programming in the next part. The reader will understand the principle of primary geometric elements (two-dimensional objects) as well as methods for creating, editing, and transforming two-dimensional geometry, such as point, line, and curve objects. There is also the descriptions and examples of various types of surface geometries for three-dimension model that are often used architectural design, such as planar and solid geometries, surface geometries, and NURBS surfaces. Including how to creation, operations, and transformations of each surface. And the last of this section, focuses on generative curve objects using three-dimensional forms and surfaces by rebuilding isocurves, point grids, and contouring. The various useful purposes for enhancing architectural design from tools and techniques for generating linework. This topic has references to Rhino features. Also, there is an example of additional tools such as Rhino plug-in paneling Tools.

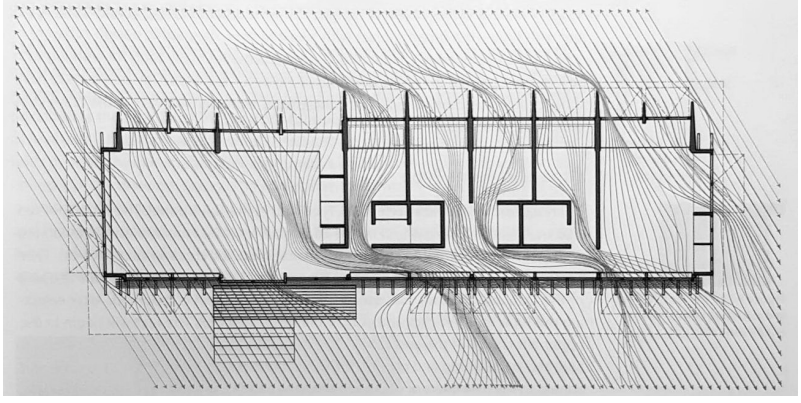


Figure 2. Glenn Murcutt, Marika-Alderton House. Digital drawing reproduced and speculative analysis (summer and winter wind flows). (Source: Melendez, F. 2019, p.185)

Part 3 Architectural Design Drawings and Graphics

This section introduces conventional architectural design drawing, such as plans, sections, elevations, axonometric projections, and perspectives, and methods for create types of drawings in digital context. This includes an overview of tools and techniques for generating linework using vector and raster-based graphics. In addition, this enhances a better understanding of file formats and workflows that support collaboration between various software.

First chapter of this part descripts types of conventional architectural design drawing which consist of orthographic, axonometric, and perspective projections. Creating two-dimensional drawing with projections from 3D models on digital context that have subject matter of viewport, cameras, and clipping planes.

Second chapter of this part, the linework into architectural design drawing that communicate architectural information (include forms and spaces) so the workflows and techniques should enhance quality of architectural drawings. The linework include particulars of line properties, color, graphics, symbols, and text. Additional topics include importing-exporting linework, vector-raster image, and setting up drawing, through the use of graphic design software which is Illustrator®, and AutoCAD® software.

Part 4 Computational Design

In first 3 parts were from conventional digital technology and impacted to architectural design but in the last part computation would play an essential role as paradigm shift in architectural process.

This section is consisted of computational design process, parametric, algorithm and programming, simulation and data visualization, robotics and physical computing.

First chapter of this part, 'Parameters and Algorithm', explain an overview of the parameters and constraints of parametric modeling and algorithmic processes in architectural process. The using variable inputs control and drive geometric properties and relationship within the model. These computational methods provide architects to go beyond the limitations of standard features within conventional software.

Second chapter of this part, 'Visual programming topic' is focused on concepts and methods for working with parameters, constraints, and algorithms through the use of visual programming based on Grasshopper. This includes an overview of interface, syntax, and workflows of visual programming for generating geometry models within Rhino® software, together with the component structure, component types, connecting components, and basic example of visual programming through the use of lists, domains, series, range, math, culling, and graph mapper components.

Third chapter of this part, 'Geometric Patterns', focus on types of patterns and methods for working with patterns using computational tools in architecture and design, Tessellations, Spirals. Through the pattern effects, such as replication, incremental rotation, incremental scaling, and attractors.

Forth chapter of this part, 'Parametric Modeling', introduces concepts and methods for working iteratively through parametric modeling process. This topic includes parametric surfaces, paneling surfaces, modular assemblies, and modularity in architectural assemblies. And there are examples of Grasshopper definition for each subject.

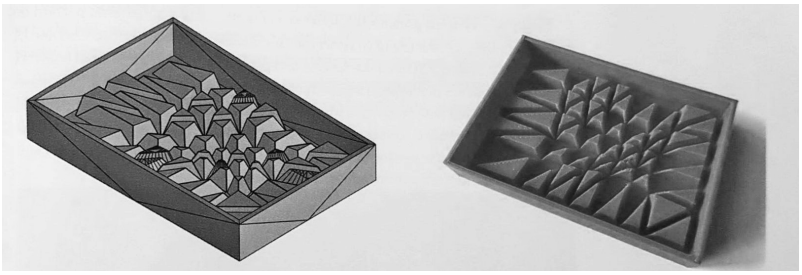


Figure 3. 3D model of the pattern mold and final 3D printed ABS plastic. (**Source:** Melendez, F. 2019, p.315)

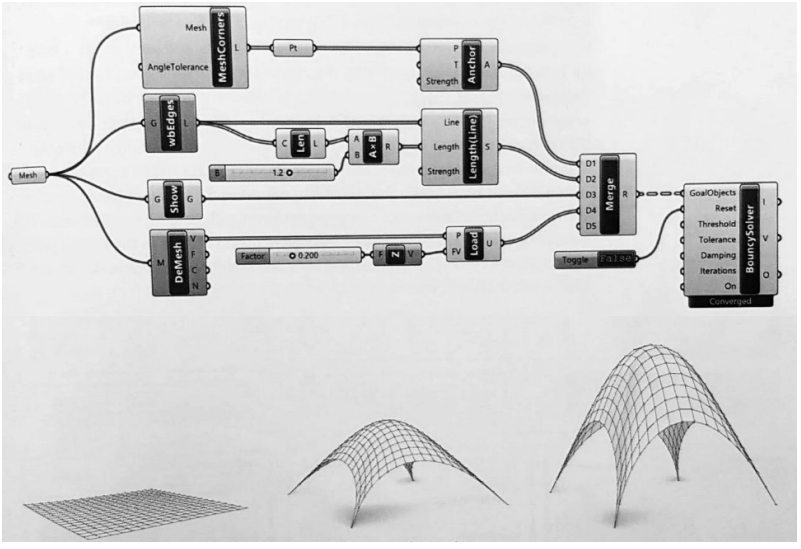


Figure 4. Iterations of relaxed surface simulated with Kangaroo and Grasshopper (**Source:** Melendez, F. 2019, p.265)

Fifth chapter of this part, Simulations and data visualizations are computational methods that support design decision in design process. This topic describes an overview of methods to analyze weather data in Grasshopper environment, through the use of Ladybug that is a visual programming add-on for visualizations and simulations. Additionally, there is physics engines for an interactive physics, form-finding, optimization, and constraint solving. For tool example is Kangaroo (a plug-in for Grasshopper). This tool is used for simulations to test the performance of a building structure.

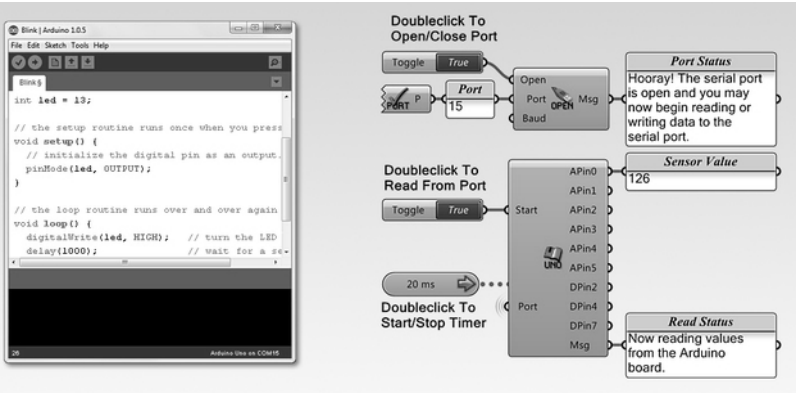


Figure 5. Firefly components: Connect between Arduino microcontroller and Grasshopper (plug-in for Rhino) (**source:** firefly, 2020)

The last chapter of this part introduces the topics of robotics and physical computing platforms as instruments, with example prototype for creating experimental drawings and visualizations by using Arduino that is microcontroller to drive drawing machines. The current uses of robotics that have influence and role in the architectural design, visual presentation, and manufacturing process. These technologies provide methods for fabrication and assembly of modular architectural systems. Concept and principle of physical computing, include introducing sensors and actuators with project examples. These tools also open up opportunities to design kinetic, responsive, and interactive systems that relate to environments. The last issue is exploring virtual and physical connection to allows near real-time data flow between the digital and physical worlds, through the use of Firefly (a free plug-in for Rhino) that is tools dedicated to bridging the gap between Grasshopper and Hardware devices.

The last section of a book comprises exercise set in the form of pedagogical framework in order to be a guideline for educational examples to practice or teach workflows that are addressed in the book. For understanding of the concepts, tools, and techniques of all content with 10 exercises that cover creation of digital drawings, digital 3D and fabricated models, computational parametric design and patterns, and mechanical devices by physical computing.

Conclusion

In conclusion, this book of Frank Melendez is integration of current and coming future computer technology in broad and varied perspectives which impact the architectural design process and concrete output through digital tools and computational processes including kinetic system creation in architecture. Several features from digital tools have affected the process of thinking, analysis, and designs. Which is the turning point in the way of connecting the design process and the architecture construction process. Impact of computer technology in this book is considered as digital disruption as leads to new working process for designer and architect. This book is easy to read and practice by examples that can serve well in academics for students and future generations of architects in order to design architectures that are based in computation, automation, responsive design, and robotics. For professional architects, this opened up new opportunities to develop skill and update knowledge of computing technology integration with professional practice.

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