



Illustrated Algorithmic Design

COMPUTER SCIENCE AND ENGINEERING

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Algorithmic Design

Never before have there been so many and so diverse tools, techniques, and methods for design. The current architectural design process already makes use of different paradigms and tools, like Computer-Aided Design (CAD), Building Information Modeling (BIM), analysis, render, etc. Adding to the collection, an entirely different manner of conceiving architecture is increasingly present: Algorithmic Design (AD).

AD defines the creation of forms through algorithms, meaning architects can describe shapes through a series of rules and constraints. Since the entities in the design are logically connected, changes applied to the parameters are automatically propagated to the rest of the model. This flexibility not only allows designers to explore a variety of ideas with no extra modeling effort (figure 1), but also eases the iteration process triggered by the changes proposed, either by clients or engineering experts.

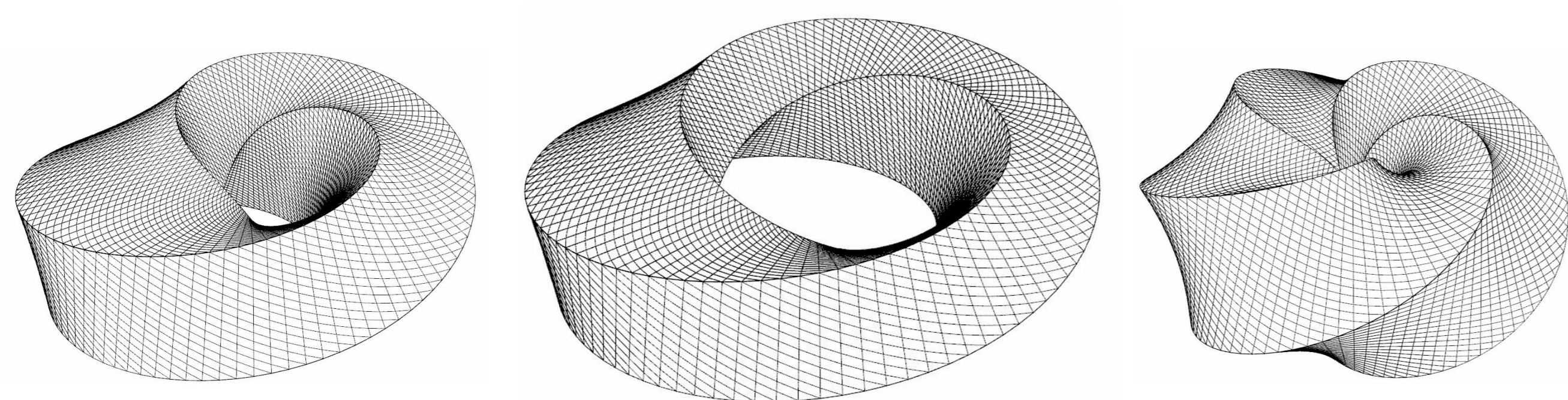


FIGURE 1: Multiple variations of shape of Astana, a recreational Algorithmic Design model of the Astana National Library project from BIG architects.

AD also holds the potential to integrate all of the necessary tools for the project's development in a seamless process. This means users can program an abstract representation of their models, which can be generated in a multitude of tools depending on its purpose (figure 2).

Slow acceptance

The numerous advantages AD presents are slowly leading to the inclusion of computer science in today's architectural firms. Nevertheless, it is still a representation method that radically differs from the current ones used in architectural practice, which demotivates many experts from its use. If architects are to truly benefit from it, two paradigm shifts must take place: (1) they must acquire basic programming skills as part of their education and training; and (2) AD must come closer to the known reality of architecture practitioners today, meaning algorithmic descriptions must be complemented with alternative representation and visualization mechanisms that appeal to architects.

Illustrated Algorithmic Design

This thesis proposes a different method of using AD in the context of architectural projects: a computational approach with which architects can benefit from AD's advantages, while working with design tools they feel comfortable with. This methodology – Illustrated Algorithmic Design (IAD) – will allow them to (1) explore and develop more challenging projects, (2) integrate different paradigms and tools in the process, and (3) receive feedback, from analysis and simulations, they can use to improve their design. A representative workflow of the IAD methodology is presented in figure 3.

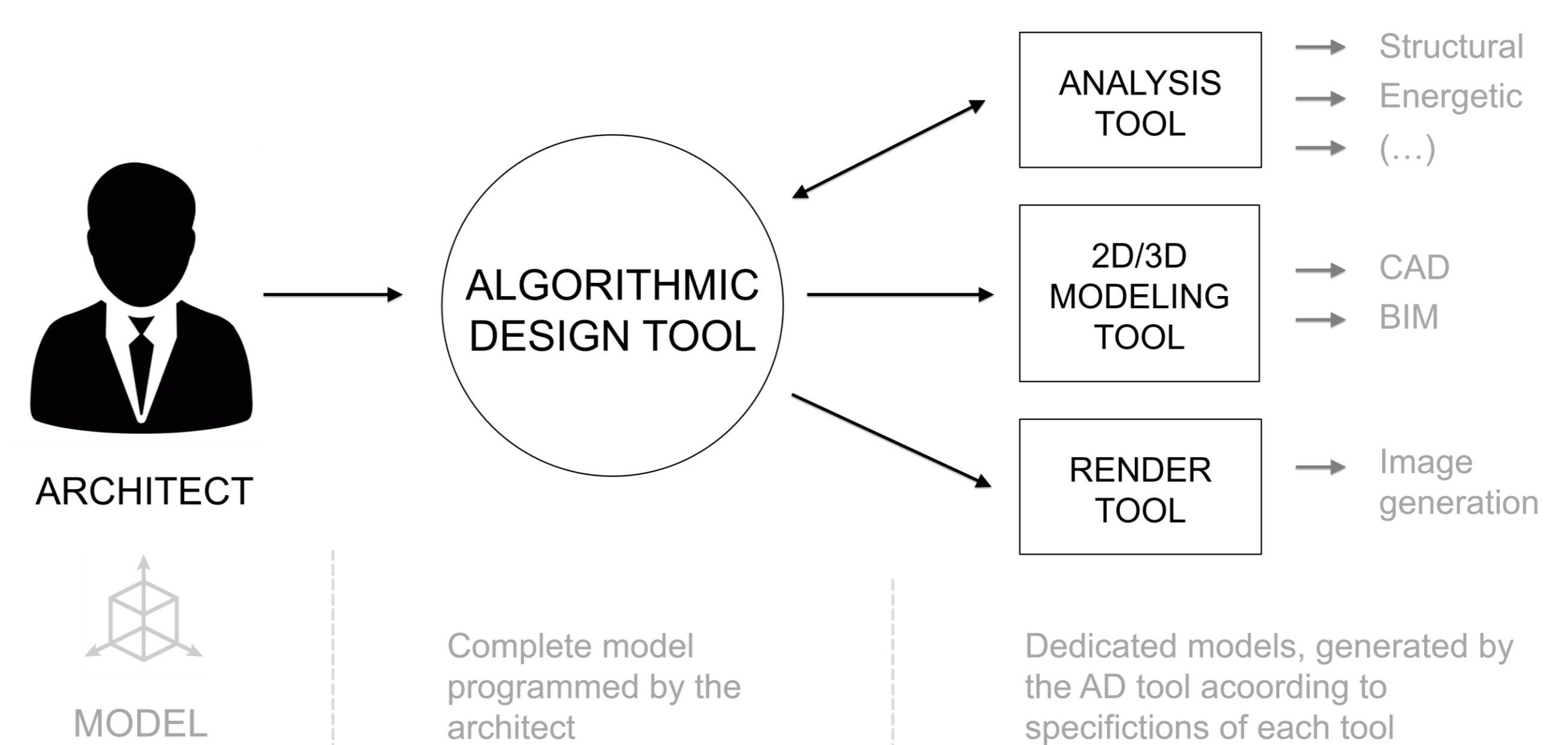


FIGURE 3: Algorithmic Design workflow applied to the modeling of an architectural project

During the course of this investigation a computational architecture guide will be produced, that depicts the following issues:

- Benefits and burdens of using AD for architectural projects;
- The necessary programming background practitioners must acquire;
- Different programming paradigms and their respective possible applications within the architectural context;
- Bringing programming environments closer to this discipline, namely by guarantying features such as traceability, immediate feedback, and sketch integration.

Merging Disciplines

The combination of the advantages computer science brings into the practice with the best representation methods the practice can offer, will not only make AD a more advanced architectonic representation method, but also a more accessible and accepted reality for architects worldwide. On the long run, a new practice may arise from the merging of these two disciplines, that takes to the extremes the currently tentative use of computation in architecture.

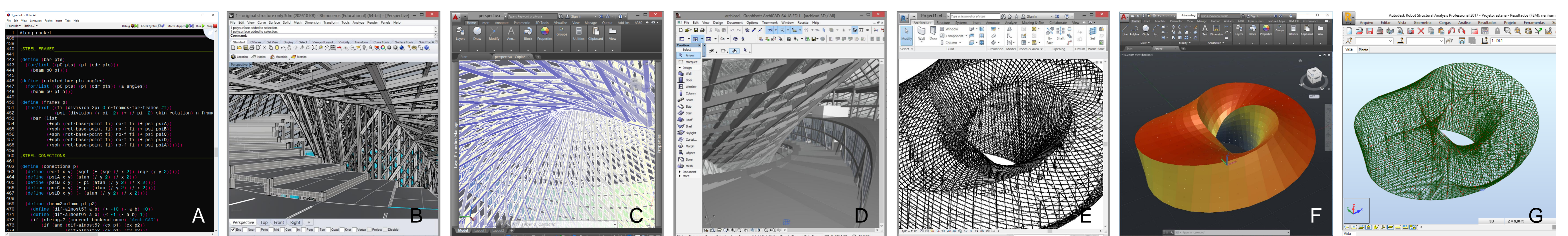


FIGURE 2: Recreational model of Astana National Library (A - algorithmic description) generated in CAD tools (B – Rhinoceros and C - AutoCAD), BIM tools (D - ArchiCAD and E - Revit) and analysis tools (F - Radiance's radiation analysis results shown in AutoCAD and G - Robot's structural analysis)