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EFFICIENT EQUATIONS

How Parametric Design is Changing Architecture



Firms Embrace Advancements in Computational Modeling

By Timothy Mansfield | Special to Banker & Tradesman | Feb 26, 2023

A guiding principle in computing over the last 50 years, Moore's Law posits that computational progress becomes significantly faster, smaller and more efficient over time.

This law certainly applies to the design and construction industry and the variety of modern day "parametric" software that has given architects increasingly powerful tools to create designs that would have been impossible to document, let alone construct, in years past. At CambridgeSeven, parametric design allows us as architects to create unique forms, streamline the design process, reduce costs and improve the user's experience. In short, parametric architecture has started to revolutionize the built environment.

What exactly is parametric design? The term parametric refers to input "parameters" that are fed into algorithms; parametric design is a method that uses those algorithmic processes to shape building form and surfaces. In this method, parameters and rules help determine the relationship between design intent and design response. These parameters can include size, shape, materials, and other design variables that can be modified to fit the specific needs and requirements of a project. Parametric architecture



CambridgeSeven used parametric design to translate the unique Voronoi diagram into a primary design element for exhibits at the new Broad Discovery Center in Cambridge. Photo by Kwesi Budu Arthur | Courtesy photo

refers to a design approach where elements of a building or structure can be adjusted using parameters, allowing for flexibility and customization.

Interestingly, while this modern computational process has become more prominent and even commonplace (the [Parametric Architecture](#) Instagram page has more than 1.2 million followers!), with newer and more powerful software technology, it is actually not without historic precedent.

One of the earliest examples of parametric design were the upside-down models Catalan architect Antonio Gaudí used to design his churches. In his design for the Church of Colònia Güell, he created a model of strings weighted down with birdshot to create complex vaulted ceilings and arches. By adjusting the position of the weights or the length of the strings he could alter the shape of each arch and see how this change influenced the arches connected to it.

Ultimately, he placed a mirror on the bottom of the model to view how it would look once built right-side-up. Gaudí's analogue method included the main features of a parametric modeling: inputting parameters, determining the equation and verifying output.

Used to Fabricate New Exhibit

Our firm, CambridgeSeven, has been utilizing several software programs that have advanced our use of parametric design on a variety of projects. For example, we recently completed the Broad Discovery Center in Cambridge, where computational modeling afforded us the ability to translate the unique Voronoi diagram, a complex mathematical equation that assists in defining cellular structure, into a primary design element for the exhibits. Additionally, our computational modeling allowed the exhibit fabricator to utilize the technology on their CNC machine operations to fabricate the design flawlessly.

On our larger scale work, we are taking full advantage of parametric processes to design highly complex architectural forms, while at the same time, advancing critical sustainability features. For a new Northeastern University academic building, CambridgeSeven's design team is fully immersed in parametric algorithms that optimize the design not only for the facade articulation, but also for energy efficiency, reducing solar glare and heat gain, water conservation, and ultimately saving energy and operational costs. Parametric design can also be used to generate construction documents, cutting down the time needed to create them manually.

Parametric architecture represents a major shift in the way buildings are designed, offering architects and designers the ability to create customized, sustainable and responsive architecture. As technology continues to evolve and become more powerful – following Moore's Law – it is likely that parametric architecture will become an increasingly important part of the architectural design process, shaping the built environment of the future.

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