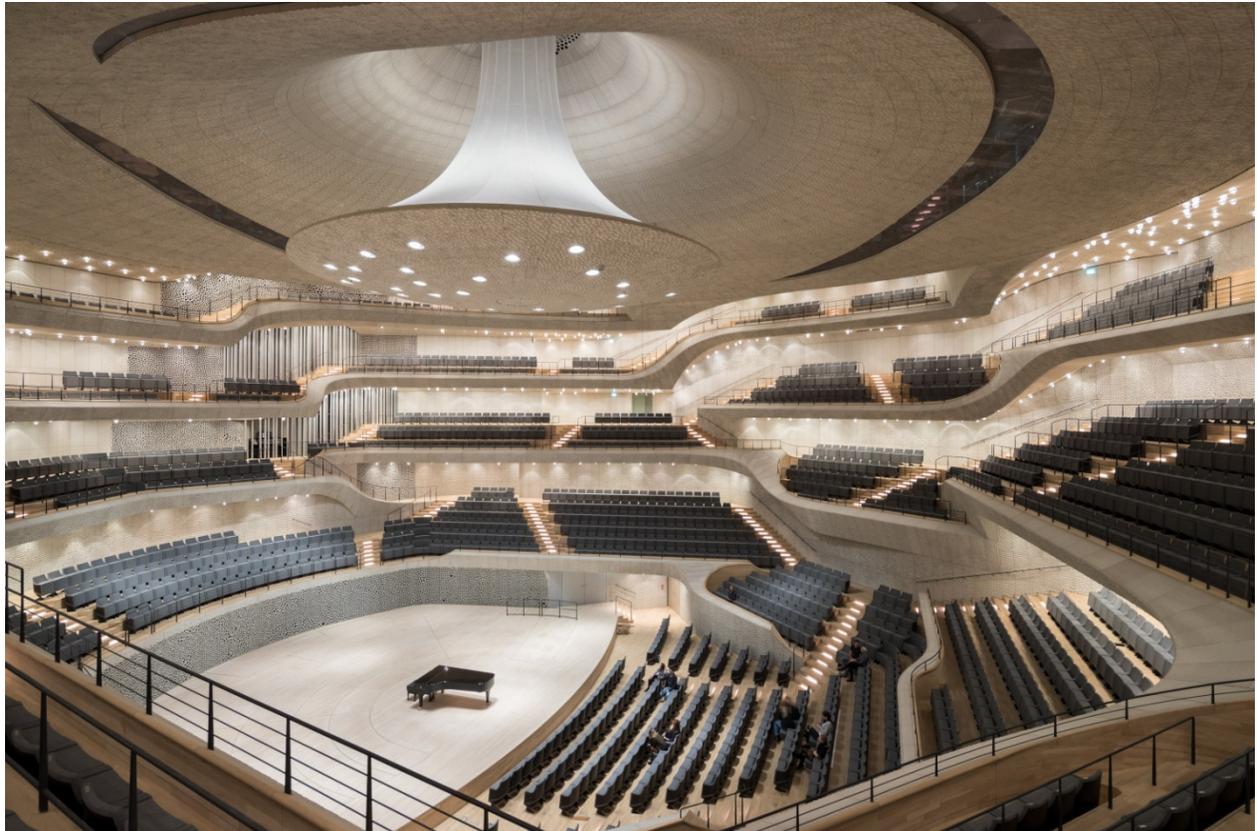


by Liz Stinson

Date of Publication: 01.12.17. 01.12.17 / Time of Publication: 9:20 am. 9:20 am

What Happens When Algorithms Design a Concert Hall? The Stunning Elbphilharmonie



The most interesting thing about Herzog and De Meuron's newly opened concert hall, the Elbphilharmonie, isn't its wave-like facade, which rises above the city of Hamburg, Germany. It's not the gently curved elevator at the base of the lobby that deposits you into the belly of the Swiss architects' alien landscape. And it's not the Escher-esque stairways that guide you from one floor to the next.

Though Hamburg's \$843 million philharmonic is filled with stunning architectural gems, its most interesting feature is the central auditorium, a gleaming ivory cave built from 10,000 unique acoustic panels that line the ceiling, walls, and balustrades. The room looks almost organic—like a rippling, monochromatic coral reef—but bringing it to life was a technological feat.

The auditorium—the largest of three concert halls in the Elbphilharmonie—is a product of parametric design, a process by which designers use algorithms to develop an object's form.

Algorithms have helped design [bridges](#), [motorcycle parts](#), [typefaces](#)—even [chairs](#). In the case of the Elbphilharmonie, Herzog and De Meuron used algorithms to generate a unique shape for each of the 10,000 gypsum fiber acoustic panels that line the auditorium’s walls like the interlocking pieces of a giant, undulating puzzle.

On looks alone, the effect is stunning. The 10,000 panels coalesce into a billowy, off-white skin, punctuated only by 2,150 seats and 1,000 hand-blown glass light bulbs. But beauty was only part of the architects’ intention when they began designing the building more than 13 years ago. “Every panel has a function,” says Benjamin Koren, founder of [One to One](#), the studio that worked with Herzog and De Meuron to design and fabricate the panels.

The 10,000 panels feature one million “cells”—little divots that look like someone used a seashell to carve out a chunk of material. These cells, which range anywhere from four to 16 centimeters across, are designed to shape sound within the auditorium. As Koren explains it, when sound waves hit a panel, the uneven surface either absorbs or scatters them. No two panels absorb or scatter sound waves alike, but together they create a balanced reverberation across the entire auditorium. This technique has been used for centuries (most famously with Vienna’s Musikverein, whose ornate, neoclassical detailing creates the same diffusion effect), but the Elbphilharmonie does it in an entirely new, visually arresting way.

To design the 10,000 unique acoustic panels, Herzog and De Meuron worked with famed acoustician Yasuhisa Toyota, who created an optimal sound map for the auditorium. Based on the room’s geometry, Toyota figured certain panels, like the ones lining the back wall of the auditorium, would need deeper, bigger grooves to absorb echoes. While other areas, like the ceiling surfaces behind the reflector and the top parts of the balustrades, would require shallower cells. Meanwhile, the architects had their own preferences. The skin had to appear consistent throughout the room, regardless of acoustic requirements; it had to be beautiful; and it had to respect the audience members (i.e. any panels within arm’s reach needed to feature softer grooves).

Using these requirements as parameters, Koren developed an algorithm that produced 10,000 panels, each with a unique shape and pattern, mapped to clear aesthetic and acoustic specifications. “That’s the power of parametric design,” he says. “Once all of that is in place, I hit play and it creates a million cells, all different and all based on these parameters. I have 100 percent control over setting up the algorithm, and then I have no more control.”

For some designers, ceding control is a scary prospect. But Koren finds it practical. “It would be insane to do this by hand,” he says. The outcome, too, might have looked less original. Designers routinely praise new and surprising forms that emerge from their collaborations with algorithms. The intricate, functional, and beautiful panels of the Elbphilharmonie are only the latest testaments to their potential.

ONLINE LINK:

<https://www.wired.com/2017/01/happens-algorithms-design-concert-hall-stunning-elbphilharmonie/>