Altair | HyperWorks®

Acclaimed Architect Peter Macapia Explores New Architectural Frontiers with solidThinking Inspire

Design Office for Research and Architecture

Key Highlights

Industry
Architecture

Challenge
Change our perceptions and convictions about how buildings could look and how they impact their environment.

Altair Solution
Use solidThinking Inspire to embark on imaginative engineering and architecture projects, integrating design and testing in the same space.

Benefits
- Inspire presented the design choices and showed the options, with tremendous flexibility in altering the forces
- Unique interactivity brings structural computation into the design activity

Customer Profile

Peter Macapia is exploring new frontiers in architectural design — a different way of looking at the design of buildings that simultaneously, rather than sequentially, employs principles of architecture and engineering to produce totally new insights and types of structures. Macapia's creativity and Altair's technology combined have brought these new frontiers within reach.

Macapia is a highly respected artist and architect who founded the experimental labDORA (Design Office for Research and Architecture) in New York and Paris. He currently teaches students architecture and urban design at the Pratt Institute in New York City. In his work and his teachings, Macapia has pursued a passion for structure, advanced geometry and computational design and scripting.

The Challenge

In exploring potential morphologies for buildings, Macapia initially worked independently to carry through research started in the 1960s and '70s in Japan, efforts that had produced genetic-type algorithms for structural morphology. Macapia describes these early computational methods as primitive in their applicability by today's standards, but they formed the basis of his early architectural work.

Macapia's mind constantly explored potentials for changing our perceptions and convictions about how buildings could look and how they impacted their environment and he needed a tool that would more easily translate his ideas.

Keywords: solidThinking, Inspire, HyperWorks, HyperCrash, Architecture

Peter Macapia Success Story

“solidThinking Inspire does what computation is supposed to do, allowing you to be in the driver’s seat throughout the project. You get a vast array of responses and ways the structure can be treated materially.”

Peter Macapia
Architect and Professor
Pratt Institute

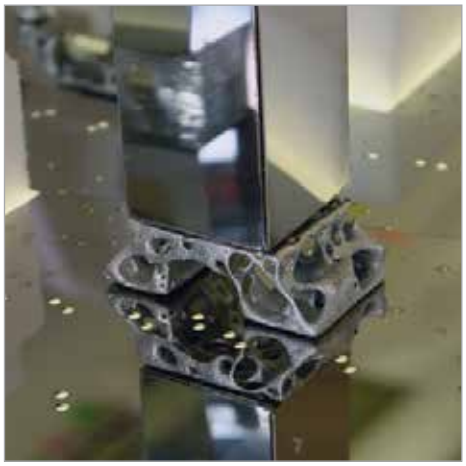
The Solution

Macapia’s own perception of what was possible in his field changed significantly in 2010 when a colleague mentioned solidThinking Inspire. At the time, Macapia was preparing a course for one of the top design schools in the world, the Southern California Institute of Architecture (SCI-Arc) in Los Angeles. “When I came into contact with the software, I realized it presented a great opportunity,” Macapia recalled. “It could allow me to take on really imaginative engineering and architecture projects, with an emphasis on the engineering side.”

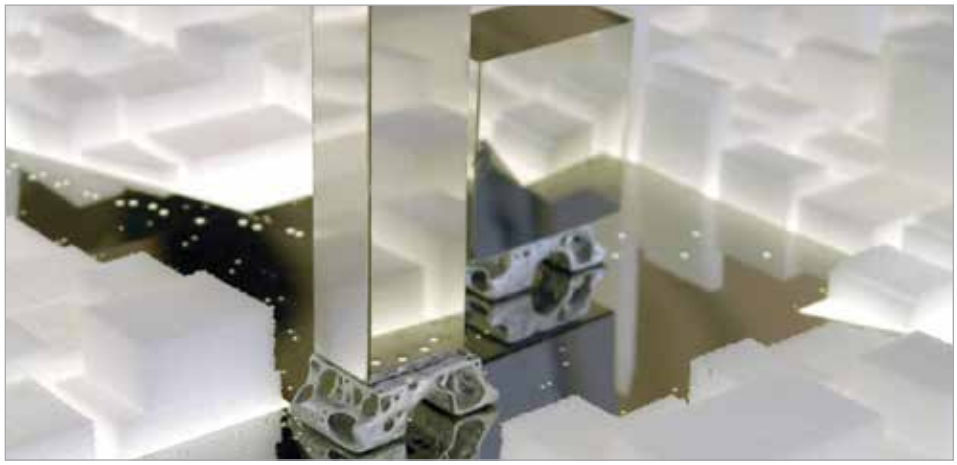
What made the difference for Macapia was solidThinking Inspire’s ability to transform forces into a design that offered alternatives for shapes, sizes and materials all at once. “Previously, you had to parse out a series of steps,” he said, “determining what you want to do structurally, what materials to try and so on. It was ideal to have a simulation produce that all at once.”

With this simulation capability, Macapia found he was able to produce many iterations very rapidly, something that could not be done with simple computation. “I could do that with Inspire, but other programs were constrained,” he noted. “I don’t have to set up the iterations now.”

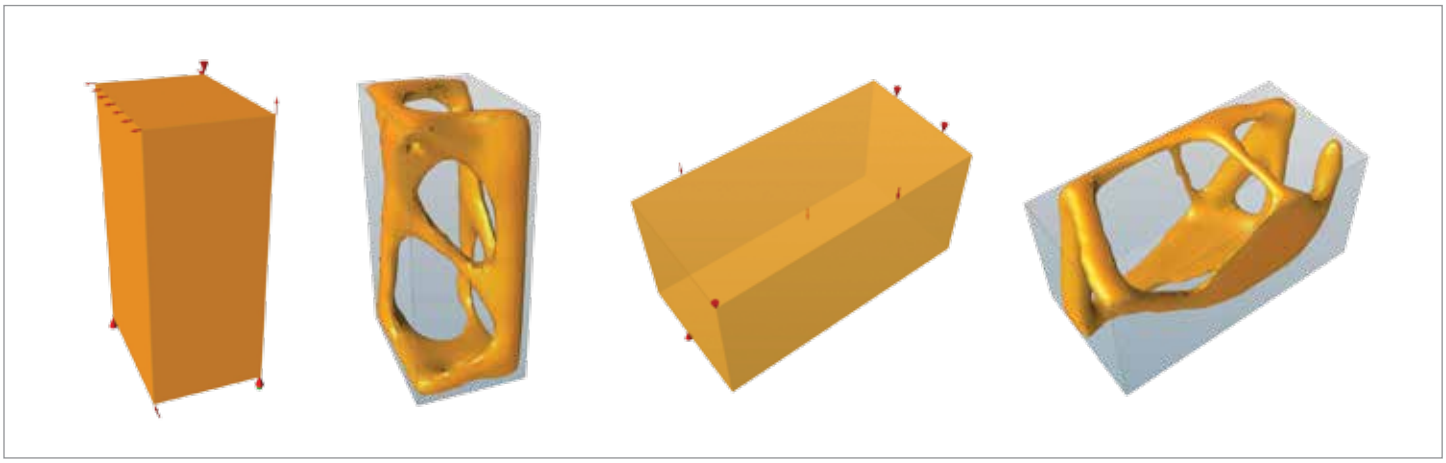
Traditionally in architecture, analysis has been completely separated from design, but solidThinking Inspire showed Macapia how designers could integrate an analytical capacity into the design space. As he observed,



Inspire's structurally optimal organic-like foundation system elevates Manhattan's towers opening the city view, courtesy of Peter Macapia



Audi Urban Future Initiative Peter Macapia's vision of the future of Manhattan, courtesy of Peter Macapia



Morphology exploration based on stress optimization in Inspire. Vida Chang, M.Arch, Pratt Institute 2012.

"We earlier could do finite element analysis, but you needed to design the structure and then test it, whereas Inspire integrates design and testing in the same space."

Results

"Using solidThinking Inspire," said Macapia, "we can introduce a new function into a cultural and linguistic environment that we already know and are familiar with. The point is to think within that new function so you invent a new language."

Macapia's new language involves structures that are designed by deforming surfaces and going beyond the rigid limits of Cartesian grids. It also forces the architect to think more deeply about materials.

"The benefit of Inspire is that it's not telling you how to solve for the design of the material, but rather it's presenting a diagram of forces and telling you what it would mean using one type of material rather than another. The fact that you can constantly specify the material and update the form you're working with is a real asset in the program."

Rather than automating architecture, Macapia contends that Inspire promotes the need for a robust group of thinkers who begin to assemble a complicated set of principles for design and materials. "solidThinking Inspire does what computation is supposed to do, allowing you to be in the driver's seat throughout the project," he asserted. "It says, these are the forces, these are the forecasts of what happens. You get a vast array of responses and ways the structure can be treated materially."

Inspired is distinctive from other structural programs. Macapia explained, "It gives you the design choices and shows you the options, with tremendous flexibility in altering the forces. You don't have that kind of interactivity in other structural programs. They are isolated from the design activity."

Macapia is interested in how other applications within Altair's HyperWorks suite of computer-aided engineering tools could be used by architects. For example, he sees opportunities with HyperCrash, the simulation software used by the auto industry to analyze vehicle impacts. He wonders if the crumpling of vehicles could be reverse-engineered and incorporated in Inspire to show how buildings could be designed with deformed shapes that are structurally sound.

"solidThinking Inspire gives us a vision for innovation as architects," Macapia said. "It's that simple. As an architect, you are trained to be able to perform adequately, professionally, but how do you push the boundaries? My job is to figure that out."

Altair and solidThinking Inspire have made that job easier for Macapia. "It's been great to work with Altair and solidThinking Inspire," he said. "The team has always been fantastic and supportive. The support has allowed me to produce research, and the generosity on their end has made it easier for me to work with students, providing tools to pose problems of the future. The tools from Altair are really open and sophisticated, and the infrastructure support has been great."

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Performance Simulation Technology

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