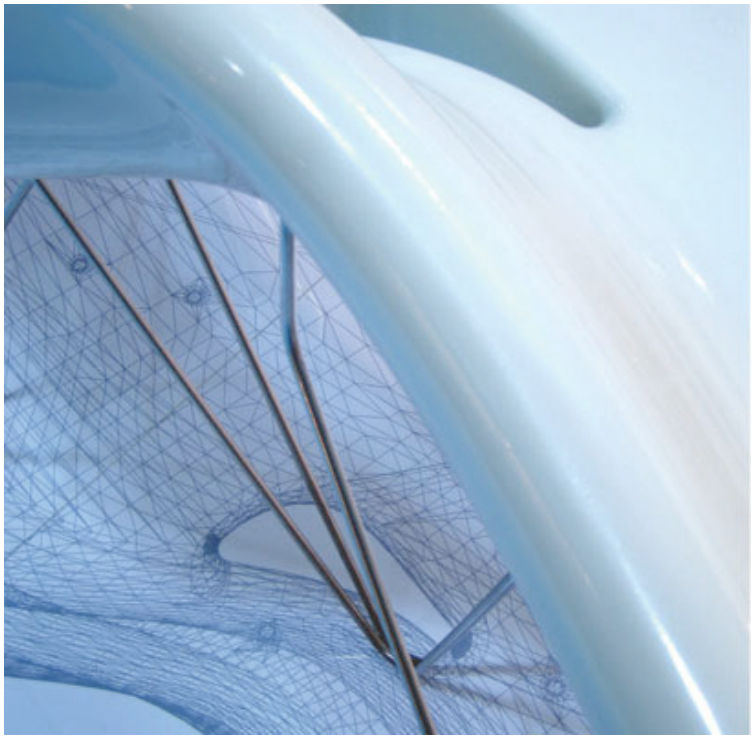
THE ARCHITECT'S NEWSPAPER
NEW YORK ARCHITECTURE AND DESIGN WWW.ARCHPAPER.COM

Issue 10_06.08.2005

The Next Dimension

CAD enters another dimension, with two new modeling approaches—building information modeling (BIM) and parametric modeling (PM)—that offer better design, analysis, and management capabilities. Are architects ready to make the leap? **Clay Risen** finds out.

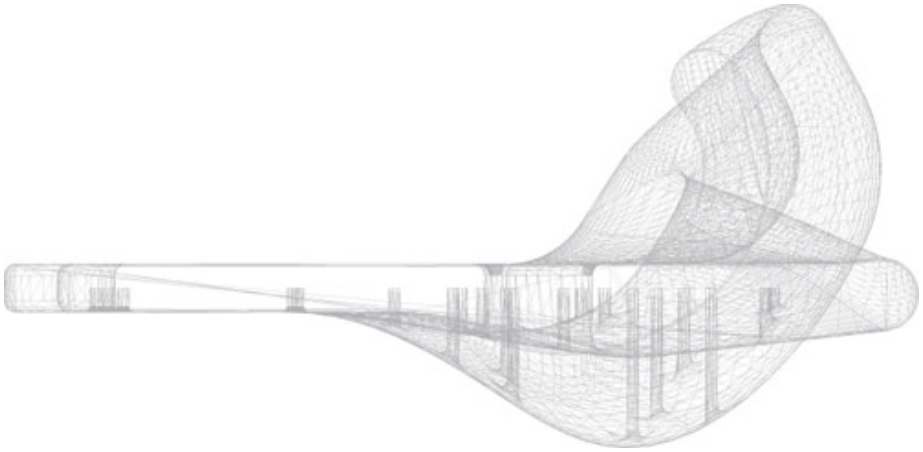


Joe MacDonald, an associate professor at the Harvard Design School teaching CATIA and principal of his own firm, Urban A&O in New York, used CATIA to design the Wave Workstation

Despite significant changes wrought by computer-aided design (CAD), blueprints and drafting pencils still define much of the architectural practice—largely because software has yet to provide an easy, standardized way to translate complex renderings into practical plans. But that may be about to change. Along two different fronts, software has gone a long way in recent years toward merging design and execution: parametric modeling (PM), which tracks and integrates design parameters set by the user; and building information modeling (BIM), which integrates building schedules, databases, and budgeting software into 3-D modeling. And while the day when PM and BIM comprise the industry standard is a long way off, they are already redefining the cutting edge of the practice.

Last fall, Gehry Technologies, a spinoff of Gehry Partners, shipped the first order of its long-awaited Digital Project, an adaptation of Computer-Aided Three-dimen-sional Interactive Application (CATIA), the PM software Gehry has used on projects like the Guggenheim Bilbao and Disney Concert Hall. Meanwhile, AutoDesk is aggressively marketing Revit, its BIM software package, having gained great publicity after Skidmore, Owings & Merrill announced its use of the program in its work on the Freedom Tower.

"It's funny because a year ago, a lot of us in the industry were saying we couldn't wait for this to happen," said Campbell Hyers of Control Group, an IT consulting firm that works heavily with architecture firms. "A lot has happened in a year. This is long overdue." Parametric modeling responds to a long-standing problem with CAD. While visualization tools, such as Maya, are great for form-finding, they are unable to generate the precise measurements needed to convert complex models into buildable plans. For that, architects must export their work into an engineering program, such as Rhino, then into AutoCAD to produce project documents. Not only is this process inefficient, but it almost guarantees that information will be lost along the way.

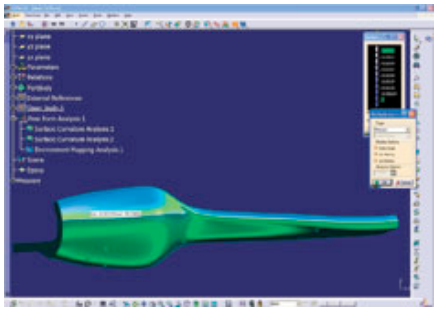


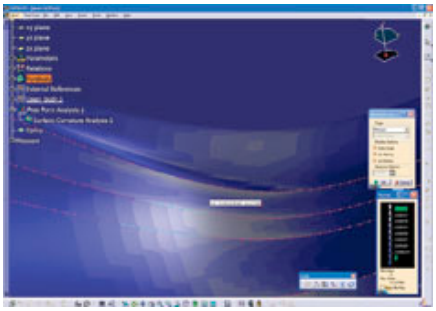
The stereolithography (STL) model viewed in wireframe, can be exported from CATIA at any time during the process to have scale models made on a rapid-prototyping machine, allowing designers to evaluate variations quickly. Any changes will be propagated accordingly throughout the model, a dynamic set of geometric interdependencies.

"All of this software hit graduate schools around 1990 and it delivered an unfortunate and unfulfilled promise of complex curves and geometries that in the end proved impossible to build," said Joe MacDonald, an associate professor at the Harvard Design School and a principal at Urban A&O, a New York firm that uses CATIA. "The building industry had no way of managing or making sense of what essentially were just sexy renderings."

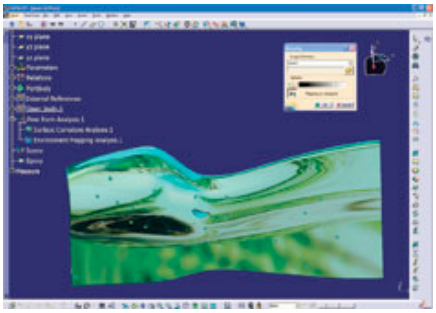
Programs with strong parametric modeling capabilities—which, along with CATIA, include Solid-Works and Bentley Systems' MicroStation—take care of all of that in a single environment and, as a result, the impossibly curvy designs rarely seen outside design school crits and Frank Gehry's portfolio will be well within reach of most firms. "We are working in an environment that offers a total simulation of a building to the point where, for example, plans and sections mean very little to our design process," MacDonald said.

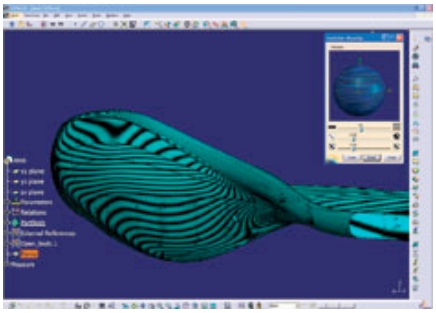
And while PM is only slowly catching on, the firms that have adopted it have proven easy converts. Soon after founding Front in New York two and a half years ago, the firm's partners—architecture-trained Bruce Nichol, Mike Ra, and Marc Simmons—found themselves in the fortunate but challenging position of working with Gehry Partners on a pair of projects, both of which required them essentially to become a parametric modeling shop. (OMA, Herzog & De Meuron, Kazuyo Sejima + Ryue Nishizawa Architects, and other firms have also come to them for technological support on various projects.) And while they have gone on to do a raft of non-PM work—"CATIA and Digital Project is a tool for us, just as AutoCad, Rhino, and Strand 7 are," said Ra— the trio hasn't shied away from using the technology to tackle one of their own projects, the SCL Glass Head-quarters and Showroom in Brisbane, Australia. For the curvy shed, built entirely of glass made by the client, PM is allowing them to do with glass what Gehry does with titanium, "imbedding information on the back end of the job that will be used for fabrication and construction," said Ra.





The CATIA model was subjected to surface curvature analyses (screen shots, far right). CATIA's automotive reflection tools were used to simulate reflections.



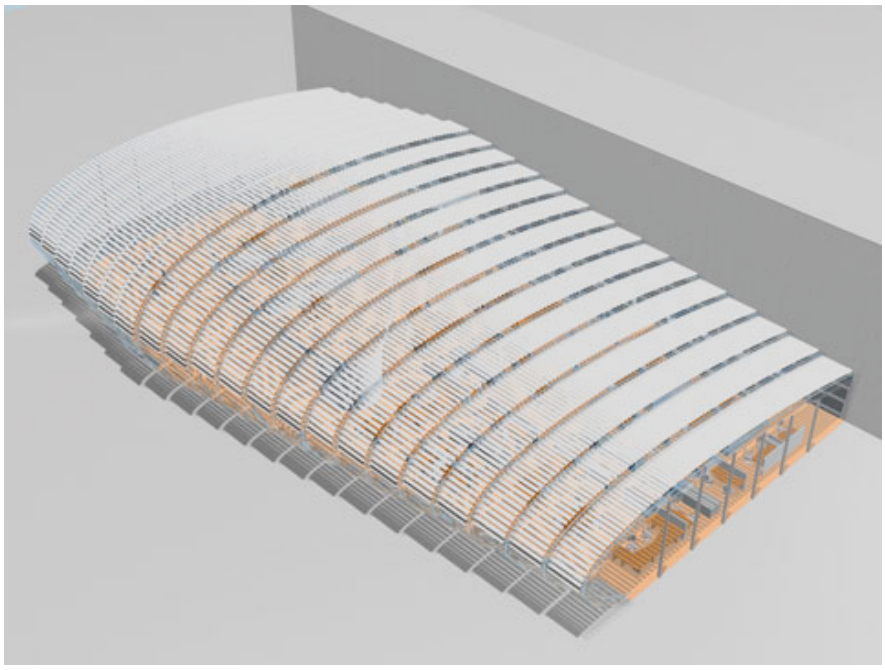


And if they decide they want to change any part of the glass-beam structure? “A rule change can be propagated into all the other glass beams that might be different in size,” said Ra. “The final payback is that the design drawings become shop and fabrication drawings. Thousands of pieces of glass that are different, and you can spit them out as usable shop drawings.”

BIM, on the other hand, focuses on improving the production process. By embedding databases and schedules within 3-D models, BIM software—such as AutoDesk’s Revit, Graphisoft’s ArchiCAD, and Nemetschek’s VectorWorks Architect—is able to quickly translate an architect’s ideas into schedules, budgets, and orders. “We can very quickly generate a schedule that shows, say, the volume of concrete required by contractors,” said James Vandezande, who oversees digital design for SOM’s New York technical group. Thus not only architects but clients and contractors can immediately see the cost and duration of a particular project, and what happens to those variables when changes are made to the design.

The two fronts are not wholly distinct: Revit contains some parametric capabilities, while CATIA can deliver some BIM functions. But their relative strengths are different, and, say experts, those differences are drawing more clearly the distinction between service- and design-oriented firms.

“The groups starting to use BIM are doing straightforward, normative buildings,” said Dan Schodek, who teaches CATIA at the Harvard Graduate School of Design. “In Revit you can do some curves and swoops, but not nearly with the design capability of parametric software. Meanwhile, you can get database output from CATIA and other programs, but life is not made easy for you.”



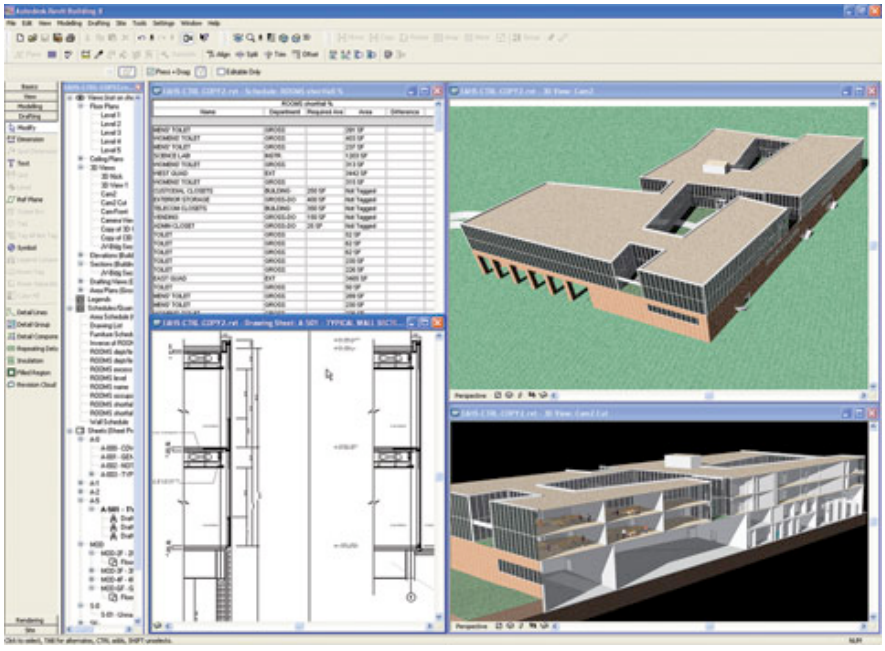
New York–based Front Inc. is an architecture and engineering firm and a parametric modeling specialist. For the SCL Glass Headquarters in Brisbane, the architects designed a shed entirely made of glass (rendering, left) to showcase the client’s various production capabilities such as curving, laminating, insulating, tempering, and shape-cutting. The building was modeled in CATIA (below) to be fabricated directly in the adjacent factory.

In theory, neither PM nor BIM is wholly new. Gehry and a handful of other architects have been using parametric modeling software for over a decade, while SOM has been using a rudimentary form of BIM for almost 25 years. But those are exceptions, and few firms have found such programs worth the time and effort.

“It will take time to get used to. Right now even rich developers can hardly afford it,” said Winka Dubbeldam, principal at Architectonics, who added that she is taking a wait-and-see attitude on the new software. “That doesn’t mean in the future that they’re not going to be more affordable. And then I would love to have one of those multiplatform things.” For the time being, though, she’s content with what she has—a cocktail of Maya, Rhino, and VectorWorks.

But most see PM and BIM as the future of the profession. For one thing, parametric modeling has begun to find a place in the nation's top architecture schools, especially as Dassault Systèmes, the French firm that owns both CATIA and SolidWorks, has sought out relationships with faculty and architecture programs. MacDonald noted, "At Harvard, CATIA made a big push." Two years ago, John Nastasi, who taught at the New Jersey Institute of Technology before going to Harvard and studying under Schodek, opened the Product Architecture Lab, a master's degree program in the Department of Mechanical Engineering at the Stevens Institute of Technology in Hoboken. It's one of the first programs in the country to rely heavily on CATIA. "It's the only tool I've found that aligns itself closely with how a building goes together," Nastasi said.

At the same time, large clients, such as the U.S. General Services Administration, are starting to demand BIM-centric deliverables as a way to speed up the construction process and improve post-construction maintenance.



Skidmore, Owings & Merrill is using Revit on the design of the Freedom Tower—the first highrise to be developed in the program—as well as more workaday projects, like the Elizabeth Academic High School in New Jersey.

And while today there is a sharp distinction between PM- and BIM-centric software, many expect that in the future the two will begin to converge. "We have environments like CATIA that are driving themselves to become more user-friendly and relevant to the architectural world," Schodek said. "No doubt those designers of [BIM software] are also trying to make their programs more robust design-wise. Ultimately there might be some coalescing."

Malcolm Davies, CEO of Gehry Technologies, said he hopes his company's Digital Project is a step toward just that sort of convergence. "We have mechanical engineering products integrated and all the function of CATIA," he said. At the same time, he added, the software has a more user-friendly interface and leaves out many of the expensive non-architectural functions in CATIA.

Indeed, the fast-paced development—and ultimate convergence—of PM and BIM technologies point to a common horizon: a seamless relationship between design, construction, and maintenance in which pure data is the only deliverable. “Ten years from now,” mused Carl Galioto, a partner in SOM’s New York office, “we will be having a drink and laughing about how we used to draw in two dimensions and delivering sheets of paper.”
CLAY RISEN IS AN ASSISTANT EDITOR AT *THE NEW REPUBLIC*.

Utility Vehicle

As software packages grow more powerful, More Complex, and more expensive, one IT firm is simplifying things for architects. By treating software and support like a utility, purchased like water or electricity, New york–based Control Group may be able to take the sting out of tech investments, and help small firms keep up with the big boys. **Sara Moss** reports.

IT guys (and they are mostly guys) are the heroes of the modern office. They fix our email when it’s not working, retrieve crashed files, advise us on hardware and software needs, debug and reset whatever needs debugging or resetting. But one firm, Control Group, is pushing the idea of technology support to another level. Just as architects hope for enlightened clients to father their procreations, the partners of Control Group—Campbell Hyers, Colin O’Donnell, and Scott Anderson—are pleased to have clients who challenge them to propose solutions that not merely support but enable more creative design processes.

When Hyers talks about the build-out of their new office, a raw Tribeca floor-through, it’s clear that he’s as much a design freak as a tech geek: He worked as an architect for half a dozen years at Rafael Viñoly Architects before starting Control Group with O’Donnell and Anderson, who have backgrounds in networks and design technology. Their office won’t need much design work, though: On any given day, it’s near-empty, as most of the company’s 19 employees are scattered throughout the city providing support for the firm’s nearly hundred clients, the majority of which are architecture and engineering firms, including Studio Daniel Libeskind, 1100 Architects, Nicholas Grimshaw Partners, Diller Scofidio + Renfro, Buro Happold, and yes, Rafael Viñoly.

Control Group is not the only technology consulting firm geared towards architects, but it is unique in its aspiration to treat technology as a flexible entity. “It started out with clients asking us to host their networks and systems,” said Anderson, pointing out the advantage of being able to check on a firm’s programs and files remotely and the potential to allow firms to share their work with collaborators. Consequently, Control Group established a server in a former army facility in Brooklyn.

More importantly, they found that most firms’ technological growth occurs in an ad-hoc, incremental fashion, which often left them stuck using systems that don’t best suit their current needs or future goals. “We hate to be the ones telling an architect that he has to invest $25,000 in a new server and software,” said Anderson.

They are now developing an idea which they’ve dubbed “utility computing,” drawing comparisons to how electricity is distributed. Early on, power stations were small, not particularly powerful, dispersed, and many people even had their own generators. The same goes for water, with people tapping into their personal or local resources. Gradually, larger centralized stations served greater areas, bringing efficiencies and savings.

Computing has gone through similar revolutions, with mainframes giving way (not very long ago) to personal computers, which kicked off the software explosion that has changed the global economy forever. But centralized computing never completely disappeared; banking and other business industries are rooted in remote networks, with local workstations serving merely as monitors, without software or memory. The biggest players in the industry, like Microsoft and Apple, who have the most to gain from PCs and individual software licensing, have persistently explored how they might play a role in restoring centralized user resources.

The design fields remain decidedly in the realm of localization. Architecture firms expand and contract with the number and size of jobs in their offices, and purchase hardware and software accordingly. For many small to mid-size firms, the initial outlay is sizable; purchasing a copy of AutoCad can cost $3,500 per employee, and with AutoDesk requiring users to pay a yearly fee for updates and support, prices climb even higher. Hyers likens the standard approach to buying software and servers to building a power plant just to light a single bulb.

With utility computing, however, firms can purchase technology as they need it. Control Group envisions a system in the future in which each user can log onto their computer in the morning and select the programs they will need that day, and pay a low rate per program, only for the days that they need it. “You could tap into it like water, by the glass,” said O’Donnell.

“We are hosting services and applications, like Microsoft Exchange, offsite for our clients right now,” said Hyers. “We are developing relationships with other hardware and software vendors to bring their particular technology to our clients in an affordable ‘by the drink’ format, and expect to release those as they are available next year.”

Clients welcome this approach. Said Paul Schulhof of Tod Williams Billie Tsien Architects (a Control Group client), “A utility-like structure seems to be the trend in other industries, especially when you are dealing with complex software. People prepare their taxes remotely online all the time, and pay for it that one time instead of buying it.” Matthew Johnson of Diller Scofidio + Renfro agreed: “Campbell has mentioned that it is something they are working on, and we could definitely use it, since the cost of software is astronomical.” “Until about five years ago, we could manage [our computing systems] on our own,” said Schulhof.

“As we took on more work and our systems grew more complex, it became harder to make sure the network was safe and protected. Also, we are doing more international work now, which means that there has to be a collaborative exchange of information, and a more sophisticated way of working on files together. Since each new piece of software adds complexity and takes time to assimilate, we like to have just what we need, not more.”

In general, many firms are now rethinking their CAD strategy (especially with the emergence of building information and parametric modeling programs), and enlisting an outside party to help them take stock and plan for the future. And, according to Hyers, the more Control Group can plan, the more it can control each client’s tech environment and working conditions. “We’re trying very hard not to become enablers of past problems,” said Hyers; that way, they can focus more on developing other ideas to help the profession function better. And it seems that there is more to come; said Hyers, “the concept of utility computing is “more of a direction than a destination.”

SARA MOSS IS A WRITER BASED IN NEW YORK.