CUTTING-EDGE TECHNOLOGY AND INNOVATIVE PROCESS FOR COMPLEX ARCHITECTURAL DESIGN SOLUTIONS

Project:
Condé Nast Headquarters Cafeteria

Architect:
Frank Gehry + Partners

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Vision

Frank Gehry had a vision of an interior world of sinuous titanium and glass for the Condé Nast Cafeteria at the Four Times Square in New York City. The cornerstone of the design was a series of compound curved glass curtains hanging in space – something never done before in architecture.

“I was thinking of a landscape,” says Frank Gehry. “The lines of the glass edges look like reeds swaying in the breeze.”

The private dining rooms of the cafeteria appear to be surrounded by billowing white curtains.

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Process

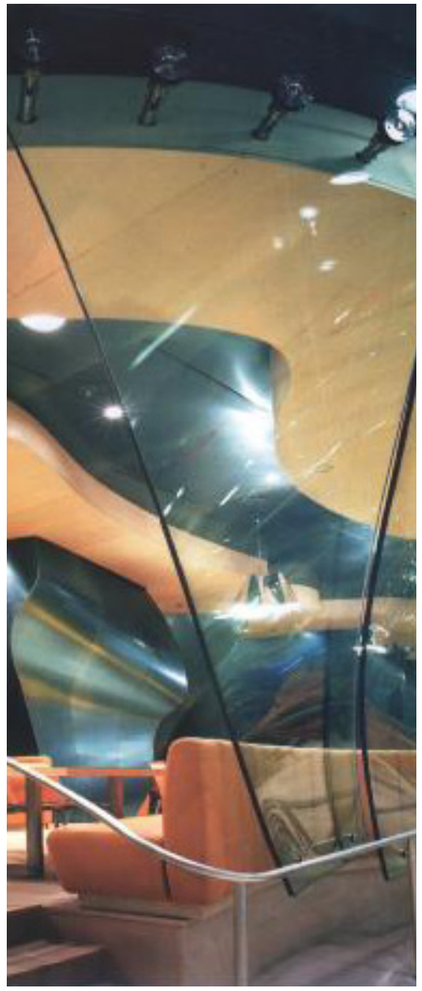
A new, innovative process was needed to turn Gehry's vision into reality. The compound curved panels required complex curved laminated glass elements – each one about 14 feet high, 5 feet wide, and weighing 800 pounds, with holes drilled in precise locations to suspend the glass with point supports. Eighty uniquely shaped, complex curved panels fill the space; when fit together, they create the effect of glass curtains hanging in space, or "swaying in the breeze." The project required the invention of a new technology for glass bending and lamination. It was an unprecedented use of CAD/CAM technology in architecture, combined with multiple CTC innovations that ultimately led to the success in creating these glass sculptures.

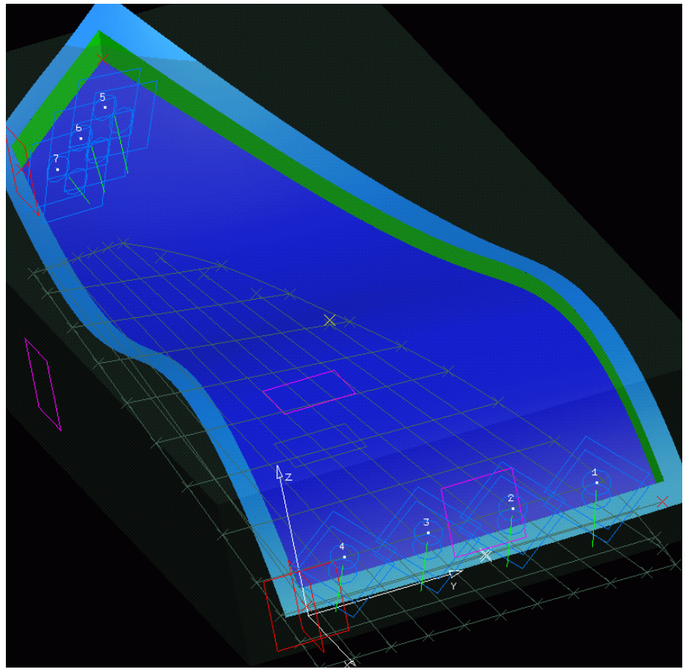
CTC Background: The CTC team's CATIA experience goes back to the late nineties when very few architectural companies were capable of engineering and fabricating using CATIA. The CTC team had done extensive work on complex compound curved glass, steel, and composites fabrication in the automobile and aerospace industries. This technological expertise forms the foundation the company taps into when it comes time to execute challenging architectural projects. While none of CTC's prior glass projects were as big as the Condé Nast project, the team did have a proven track record for prototyping and fabricating complex designs in multiple materials ranging from glass, steel, and composites, to exacting dimensions from CATIA data.

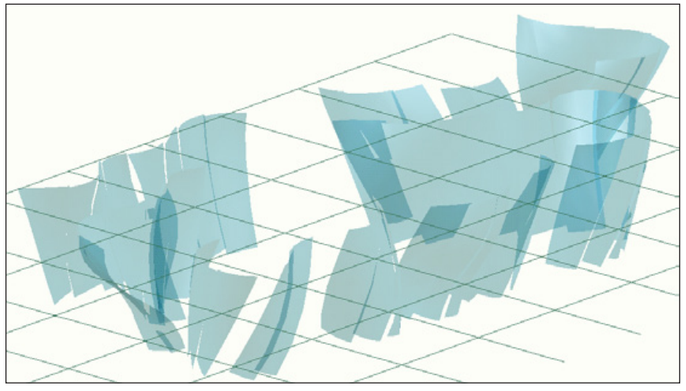
Armed with an arsenal of state of the art equipment and an innovative spirit, CTC president Eric Adickes was confident venturing into uncharted waters. Standing over the scale model, Frank Gehry asked if it "could it be done," to which Eric replied, "Yes, it could be done." CTC was able to produce a 1:1 prototype within four months, proving the technology and helping the entire project team feel comfortable with the challenge.

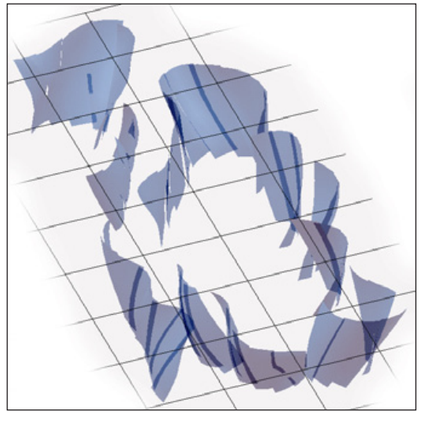
The project was technologically complex. The curtain effect requires the 800 pound glass pieces be held and cantilevered at the top by specially engineered point supports that hold the entire weight of the glass.

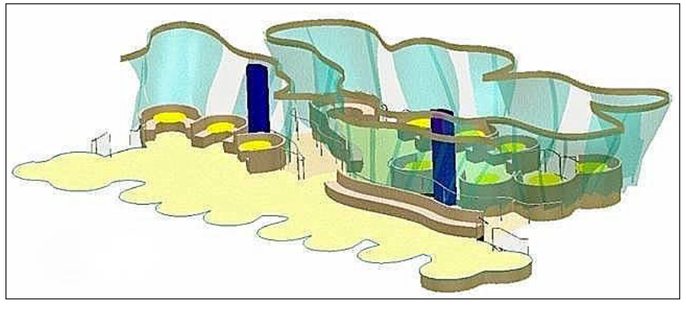
The approach used to tackle the multiple challenges of this project was to produce conceptual sketches at each stage, which led to innovations. Then the team used CATIA to analyze material tolerances, capturing real data from trial and error testing, which eventually led to the successful prototype. Technically, the data communication was not a huge challenge, given that Ghery's office at the time was using CATIA to generate versions of the geometry.











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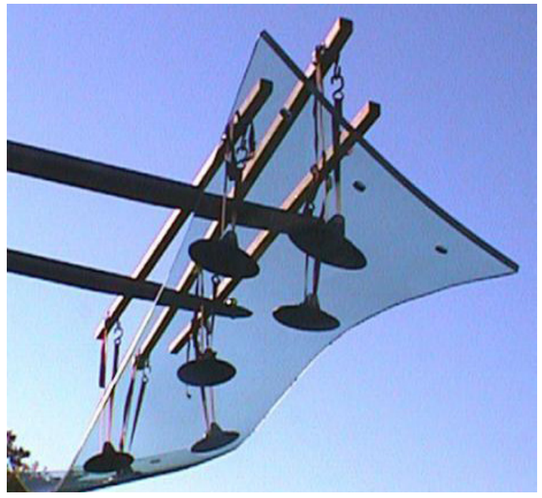

FOUR KEY TECHNOLOGICAL / TECHNICAL BARRIERS:

Innovation #1: "Jumbo-size compound curved glass forming." The project required the CTC team to design and build an in-house, new, jumbo-sized glass forming oven specifically designed for creating compound curved geometry glass up to 18 feet long. This first step had to be executed in six weeks in order to fabricate one prototype for approval prior to production. Specialized tooling was specifically created to go inside the oven to form the glass to within +/- .10 inch tolerance over 14 feet. The custom made oven and the tooling worked in conjunction to form the 800 pounds of glass to exacting tolerances.

Innovation #2: "Liquid Lamination." Jumbo-sized compound curved glass with extreme angles and curvature can't be laminated using conventional auto clave processes, so a new lamination technology was simultaneously developed. This new liquid lamination technology allowed the glass panels to be laminated without inducing stress in the two annealed glass panes – and for the first time, exposed polished edges were produced that were flawless and also waterproof. (Typically, auto clave laminated glass polished edges experience visible delaminating and bubble chips, and over time are not waterproof.) The fabrication precision of the panels was unprecedented and no error could be made in the geometry that could vary the space where the liquid resided.

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Innovation #3: "Five axis hole drilling." A major challenge was the precision needed at the connections. The final holes in the glass needed to mirror the CAD data exactly, given that the point support hardware also needed to be exactly positioned on site, prior to the installation of the glass panels. Each hole needed to be precisely positioned and drilled in five axes in order for the weight to be distributed evenly from hole to hole, as designed in CATIA. If one of the holes was a fraction out of position, the entire 800 pounds of glass would point load at that location, resulting in cracking and failure. The CTC team innovated this process and the integral hardware interface design to achieve this feat of even point loading. There were approximately 610 holes, every one uniquely positioned in space. Not one hole in the entire 80-panel system has cracked from point load.

Innovation #4: "Precision Hardware." Because of the glass geometry and its location on site, special precision hardware was developed that could support the 800 pound panels. Full-size mock ups were built and hung to perfect and refine the final hardware design. This hurdle proved daunting. Two completed prototypes were broken during this last phase of dialing in and changing the final hardware design.

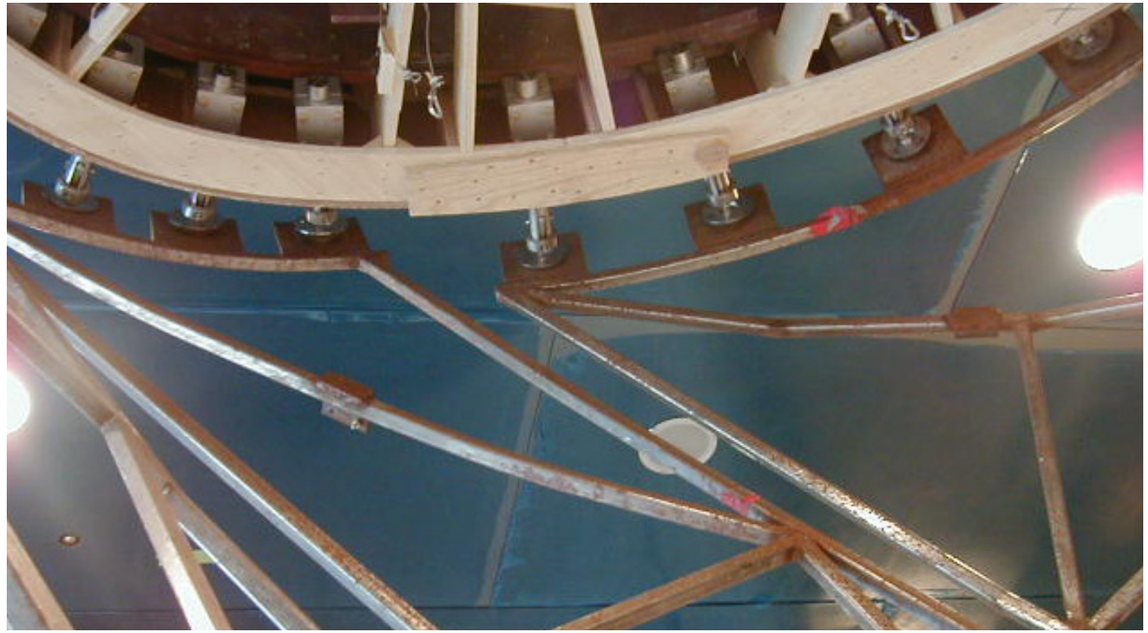
In the end 15 prototypes were made during the R & D process to achieve the final perfect prototype – and Frank Gehry's vision was then realized.

Installation

The final key component to the project's success was the installation support. The CTC team developed the installation process and strategy, and provided the supporting equipment and people necessary for the successful fitment of each of the 800 pound panels. All the glass panels were delivered prior to the date required, making the installation planning process much simpler for the entire team.

This is one of the hallmarks of CTC technology, and a proven turn-key project delivery methodology from precision manufacturing to installation on the site. CTC accepts accountability of the design, manufacturing, and installation for most projects, providing a one stop turnkey solution for their clients.

In the case of Condé Nast, the stainless steel hangers were located on site before the glass panels were installed. With all the details factored in the engineering, precision fabrication, and a foolproof installation plan, each one of the uniquely shaped glass pieces fit in place perfectly.



Result

The Condé Nast cafeteria was a huge design success for Frank Gehry and Condé Nast Publishing. The glass curtains blend perfectly with the design flow, making it a cornerstone of the successful ambiance and experience that was created.

“We were one of the first companies to pioneer the use of CATIA for analyzing and executing complex geometries in architectural projects, and the first company to fabricate compound curved glass panels of this size,” says Eric Adickes, President of Creative Teknologies Corporation. “We have been doing it now over 17 years, for a variety of architectural applications. Our experience in the automobile and aerospace industry has given us the technical edge for designing integrated systems in different materials and the fabrication of complex geometries, including very high-end detailing. With our engineering expertise, in-house fabrication, and installation capabilities, we are able to minimize the project risk, creating the right process up front, including budget analysis and prototyping during the DD phase. We enjoy the challenge of pushing the technology envelope on projects like Condé Nast and are passionate about our work.”

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To whom it may concern:

I am writing this letter to express our experience working with CTC on the Condé Nast Headquarters Cafeteria Glass Project.

The project was an interior fit out for a publishing company's in-house cafeteria. The design consisted of a kitchen/server area, and a seating area comprised of banquettes. The perimeter walls were clad in titanium, and each of the interior banquettes was back by curved glass panels. The difficulty in the design for the glass was the curvature was compound (two-directions), and each had to be laminated.

We approached several companies, and each created a prototype to demonstrate their process and product. CTC's technical background and expertise allowed them to create successful, high quality prototype, which gave us the confidence they could deliver the glass panels.

CTC's team provided a turn-key solution to a very complex undertaking, their engineering and fabrication team innovated the manufacturing process that realized this design vision.

CTC was very collaborative, innovative and supporting of the design scheme.

I would happily recommend CTC for the projects in the future.

Best,

Tensho Takemori

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