Facade Engineering Emerges as a Highly Specialized Science and a Striking Art Form

THE MODERN CURTAIN WALL HAS EVOLVED FROM STATIC WRAPPER TO ACTIVE BUILDING SYSTEM

By Sara Hart

In *Building Skins* (Birkhauser), Christian Schittich writes, "[In the Fagus Works shoe factory (1911–25)], Walter Gropius succeeds in collaboration with Adolf Meyer in suspending a curtain wall in front of an industrial hall as filigree, transparent skin that no longer has any load-bearing function and clearly announces this freedom." He and other pioneers of Modernism liberated the building skin from the load-bearing frame, and there was no going back. Such liberation, however, absolved the facade maker from any obligation to the interior. Architects make careers out of creating wrappers for undetermined spaces.

Today, facade engineering is synonymous with curtain-wall design, which is to say that every facade is a curtain wall. Facade innovation first came in the form of incremental improvements—more energy-efficient glazing units, structural sealants, lighter materials. More recently, innovation has been associated with new products—new composite materials, high-strength concrete, fabrics, and photovoltaics.

The following projects show that real innovation grows out of successful problem-solving, whether it be in response to the impossible site or in developing systems integration.

Between bedrock and a hard place

The Austrian Cultural Forum (this issue, page 122) was wrenched vertically out of the ground and stuffed horizontally into what can only be called a mean fissure in a tightly packed urban block of Midtown Manhattan. The program for the building, which is only 25 feet wide and 81 feet deep, called for a 24-story structure on the site of a former town house. This incredibly tight space created a multitude of challenges for Austrian architect Raimund Abraham in his first American commission.

Raimund Abraham's Austrian Cultural Forum in Midtown Manhattan slopes away from the street in accordance with strict zoning regulations.

The building envelope was the major design problem from the onset—how to give an iconic presence to the entrance facade while meeting New York City's stringent zoning requirements.

Project manager Simone Giostra oversaw the development and installation of the glass, steel, and aluminum curtain wall. (The side and rear facades are clad in Rheinzink—a zinc, copper, titanium alloy with highly uniform properties important in facades.) From the beginning, the challenges were daunting for construction of the entire building. There was virtually no staging area for equipment and materials. Deliveries had to be small and precisely timed. With little room to stage the erection of the facade, Barney Skanska, the concrete subcontractor, used special forms built on-site. Above the 14th floor, the contractor switched to a jump-form system from Doka, an international formwork company. The system is a self-supporting concrete formwork, anchored to the lower portion of the same concrete wall under construction. It can be erected without any additional scaffold or support from the ground.

CONTINUING EDUCATION

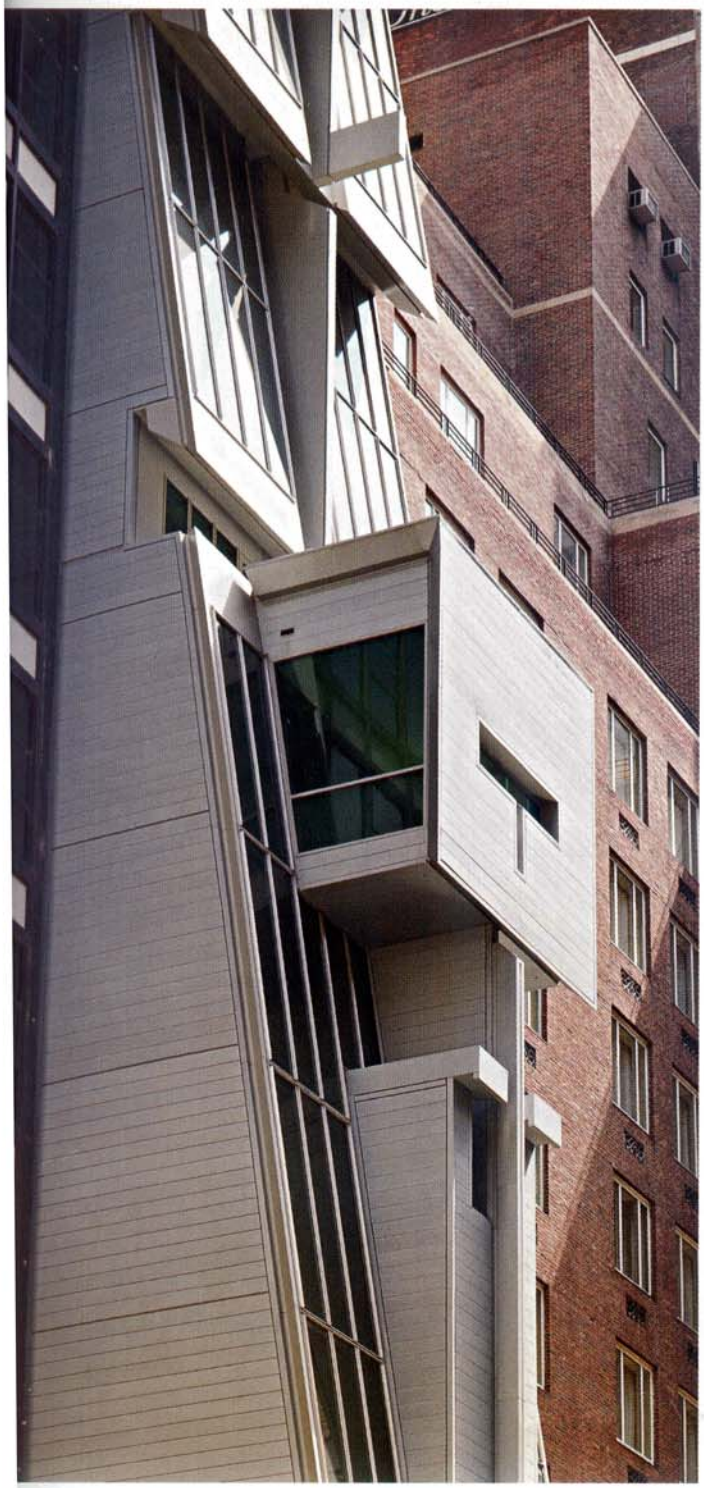
Use the following learning objectives to focus your study while reading this month's ARCHITECTURAL RECORD/ *AIA Continuing Education article and the article about Raimund Abraham's Austrian Cultural Forum on page 122. To receive one health, safety, and welfare credit, turn to page 170 and follow the instructions.*

LEARNING OBJECTIVES

After reading this article, you should be able to:

1. *Describe innovations in facade design.*
2. *Explain how the facade works with other building systems.*

www For this story and more continuing education, as well as links to sources, white papers, and products, go to **architecturalrecord.com**.



The facade composition directly relates to the functions in the interior. The director's office (above) projects from the glass wall.

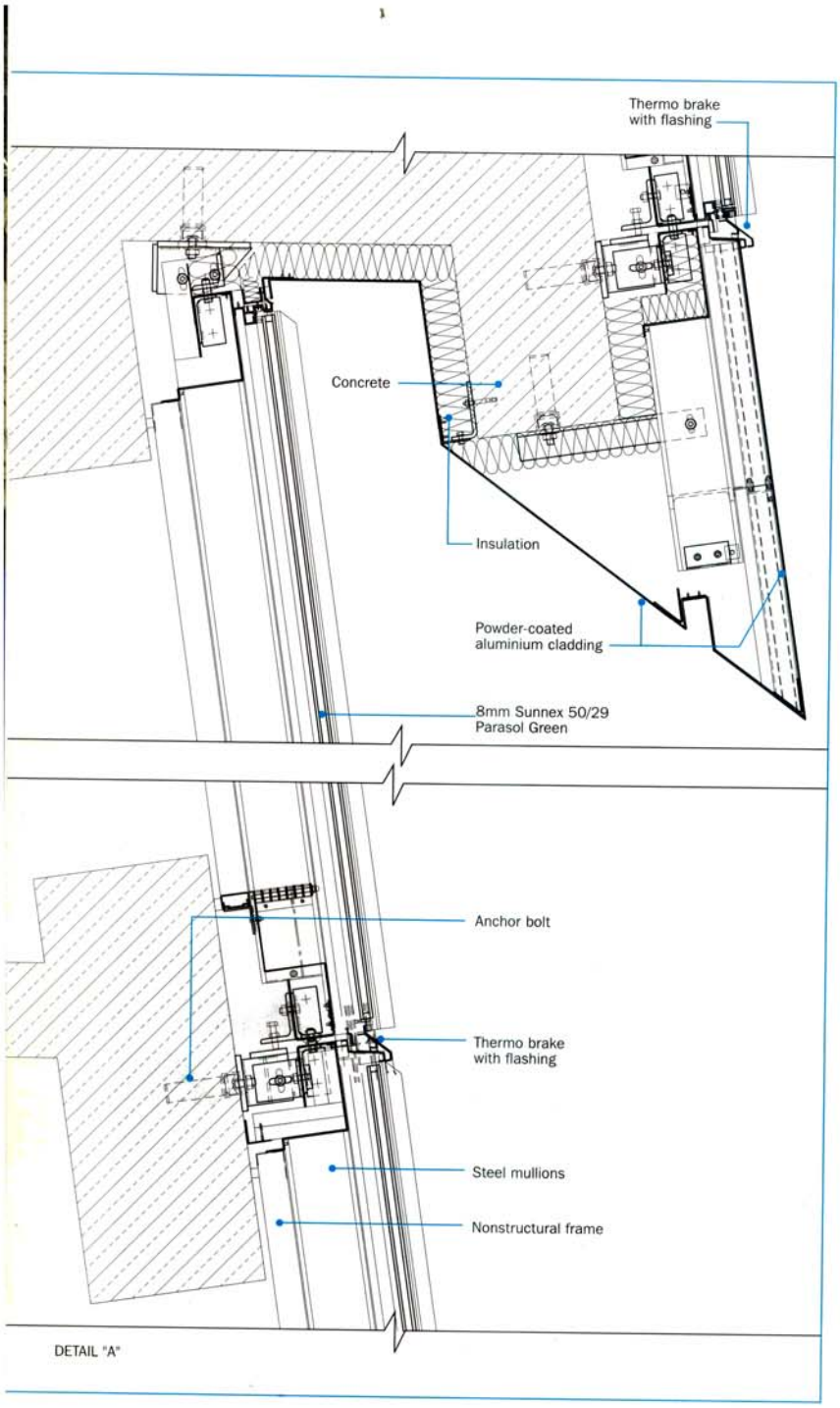
The south-facing entrance facade is a complex assemblage of materials—high-strength concrete, architectural concrete, aluminum and glass fenestration, and steel cross bracing. The architectural concrete (8,000 psi) was to be visible through the curtain wall, so the interface between panel and concrete was critical.

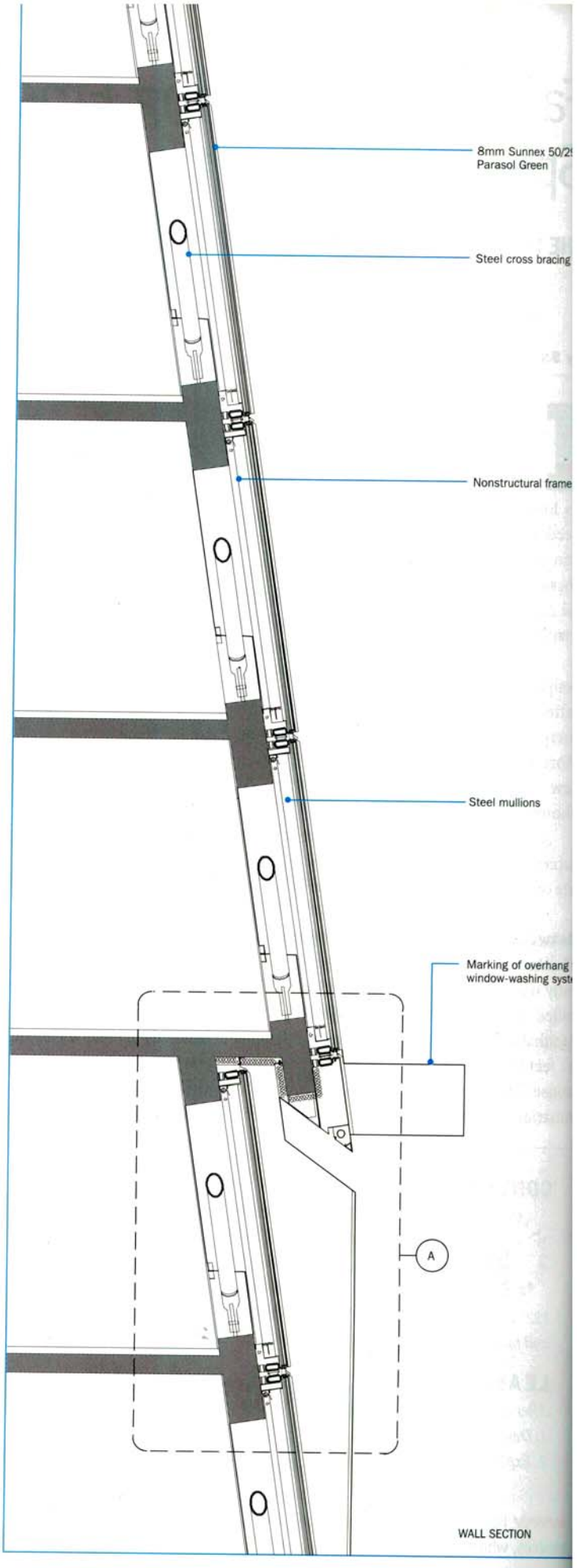
The fabrication and installation of the south facade was plagued by what can only be described as a clash of building cultures. The facade's glazed panel system was fabricated by an Austrian company called GIG Fassadenbau GmbH, but the structure on which the curtain wall was to hang was built to American standards. "In Europe, the tolerances are much tighter than in the U.S.," Giostra explains. "Whereas the panels were designed with a tolerance of $\frac{1}{16}$ of an inch, the concrete structure allowed for as much as 1-inch variance." Furthermore, the design called for the architectural concrete to be visible through the curtain wall, precluding any workable but visually unacceptable solutions. Because of the discrepancy, the brackets connecting the curtain-wall panels to the concrete superstructure required a survey of the entire south elevation and fabrication of new steel brackets, which could absorb much wider concrete deviations.

It has been described as a puzzle by the engineers, the contractors, and the construction manager. It might be more like building a ship in a bottle, fashioned with European precision and American perseverance.

Process is innovation

The era of facade as passive envelope is over. Its demise is long overdue, according to the late Reyner Banham, who in 1969 wrote in *The*

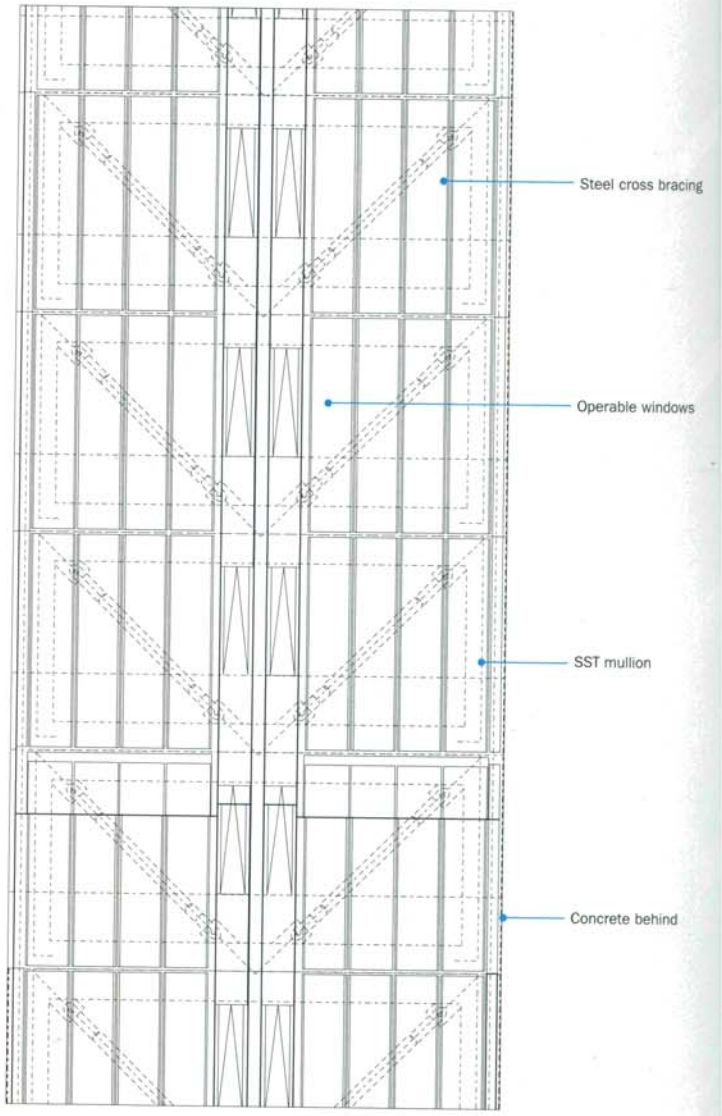




Austrian Cultural Forum, New York City

The south facade of the 33,000-square-foot building is a glass, steel, and aluminum curtain wall. The facade slopes 11 degrees away from the street in order to meet the city's setback requirements. No special permits were needed. The overall structure is high-strength concrete, and the curtain wall is fastened to the structure with brackets. The facade is cross braced to prevent vibrations caused by wind loads.

Arup's New York office engineered the facade, as well as the mechanical, electrical, and plumbing systems. Wind-tunnel tests showed that the building would be subjected to uncomfortable vibrations. The engineers stiffened the front facade with steel cross bracing. Because the steel is for stiffening only, the bracing did not require fireproofing.



CROSS BRACING DIAGRAM

Architecture of the Well-Tempered Environment that the intellectual division between structure and building systems is patently false. He lamented that discussion of what makes a building habitable rarely goes beyond space-making and form-giving. As sustainability becomes an assumed goal, such thinking seems counterintuitive. If he were here today, Banham would be glad to see the recent trend away from this segregation of building functions to what is often called "the whole-building concept," in which all the systems—HVAC, plumbing, electricity, structure, and the building skin—are designed to be interdependent. To some engineering minds, it is in the process that realizes the whole-building concept that real innovation is to be found.

A HIGH-QUALITY FACADE MUST BE ENGINEERED IN THE EARLIEST STAGES OF DESIGN DEVELOPMENT.

A successful example of this can be seen in the Sobanski Palace in central Warsaw, Poland, designed by Dublin-based A&D Wejchert Architects and engineered by Buro Happold's Bath, England, office. Stephen Tanno, group director at Buro Happold Facade Engineering, applied the firm's process theory to an office-buildin addition to the palace.

A high-quality facade must be engineered in the earliest stag of design development. Tanno believes that the traditional approach t facade design, which has a specialist contractor arriving on the scene onl after the construction documents have been bid, does not work well fo complex projects. First of all, the facade contractor comes in too late afte the design has been fully developed and tendered. At this stage, it is eco nomically impossible to change the fundamentals of the documents. Bu more important, in a situation where the building envelope is integral t environmental performance, contractors too often don't understand th interdependence of all the systems, even though they are experts i cladding and know their own facade systems extremely well. If the con tractor—or the engineer, for that matter—comes in too late, too muc time is spent revising details in the shop drawings.

Tanno relies on a rule of thumb to tell him if his process-oriented approach is working. "When the facade package is tendered, i the bids come in within 10 percent of each other, then the document were clear and complete," he says. "By going the traditional route, I've seen bids can come in as much as 100 percent apart."