7 WORLD TRADE CENTER

Stainless Steel and Glass Deliver Beauty and Blast Resistance

It was inevitable that the first building to rise from the World Trade Center site, called simply 7 World Trade Center, would carry a heavy symbolic burden. Though not hit directly by the airplanes on September 11, the original building suffered fatal damage when the twin towers collapsed. Within weeks, however, the property's long-term leaseholder, Silverstein Properties, had announced that the building would be the first to be rebuilt, and by early 2002 work was fast underway on the 1.7 million-square-foot tower.

But Silverstein Properties' president, Larry Silverstein, and his architect, David Childs of Skidmore, Owings & Merrill, had a problem. The building's entrance and lobby had to be both aesthetically pleasing and safe enough to withstand a terrorist attack. Not necessarily helping the matter was that the building's first five stories, which would house a Con Edison substation, essentially had to be a concrete cube. How could they make such a façade both inviting enough to attract the sort of class-A tenants they hoped would fill the upper-story offices and secure enough to withstand potential blast? The answer in both cases was stainless steel.

Early in the process, Childs turned to James Carpenter, a renowned architect and glass and steel sculptor who had a long history with SOM. For the entrance, Carpenter adapted a design he had employed on an earlier SOM project, the Time Warner Center. Instead of trying to resist a blast with a static façade—which would have meant smaller windows and thicker walls—Carpenter designed a Cable Net Wall that meets the necessary resistance. "As the cable net distorts, the cables get longer and that means the glass panels separate from one another, increasing the gap between them. In the corners we've accommodated for this slippage," said Carpenter. "Most blast resistance is accomplished by stiffer and deeper mullions, or by smaller glass lites to take the force of the blast. This approach allows for and anticipates the absorption of energy by acting as a dampening device."

Fabricated by Josef Gartner Germany and Allied Bronze LLC of Long Island City, NY, the Cable Net Wall has a support grid of braided stainless steel cables that run horizontally and vertically across the entrance façade. The 22-millimeter-diameter horizontal cables were tensioned to 28,000 pounds and the 26-millimeter-diameter vertical cables were tensioned to 42,000 pounds to prevent swaying. Sixty Duplex Grade stainless steel milled fittings clamp the cables together at their intersections and support the five-foot by seven-foot panels of low-iron laminated glass, treated with a PVB interlayer.

The lobby entrance itself, directly beneath the Cable Net Wall, also employs Duplex Grade stainless steel, the highest strength stainless steel available, and the same low-iron PVB laminated glass, to ensure a degree of blast resistance. Separating the entrance from the Cable Net Wall and providing support for the Cable Net Wall's base is

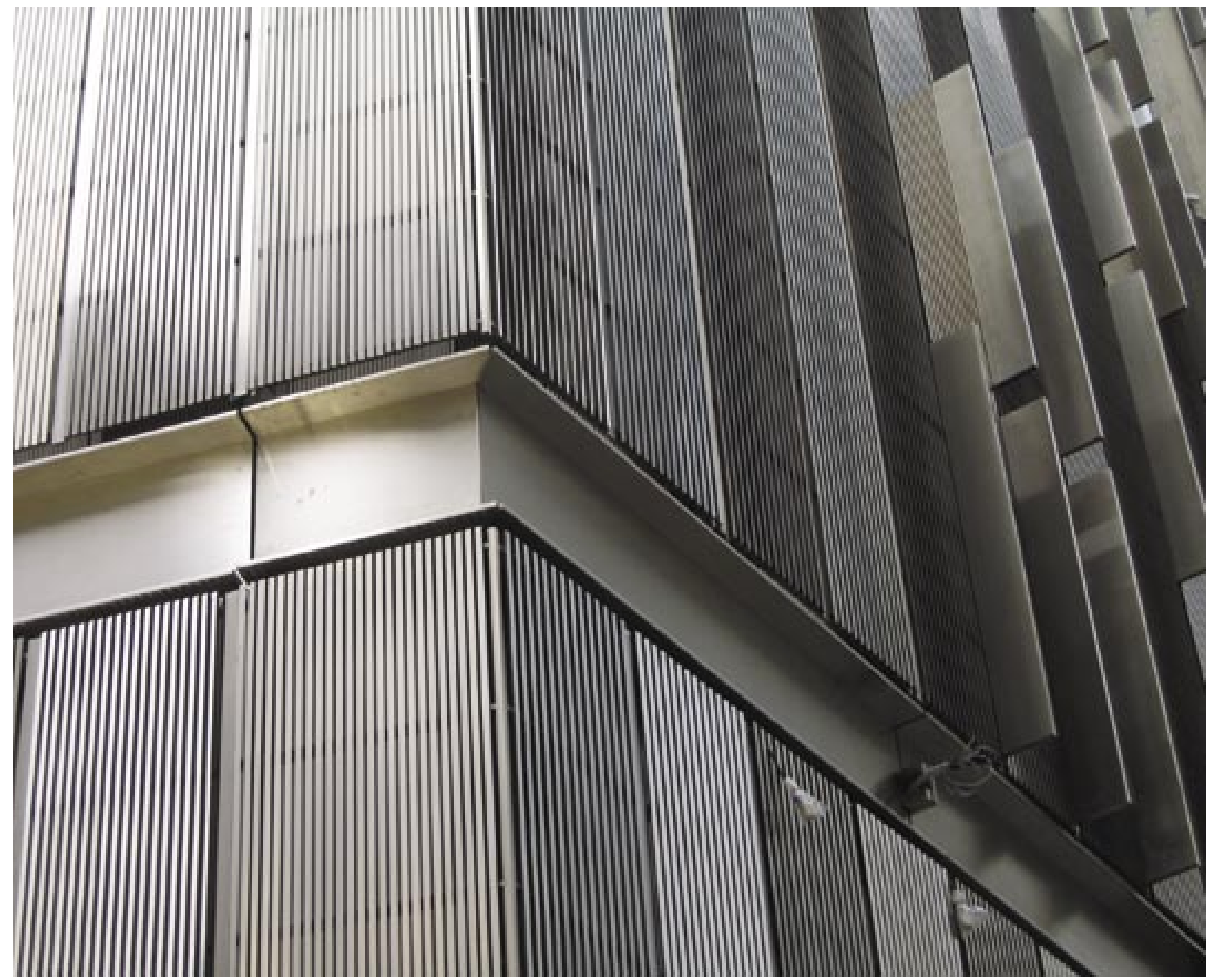
OPPOSITE The lobby columns sit only a few inches from the cable net curtain wall.

RIGHT Clamped connections on the cable net curtain wall

a 100-foot-long stainless steel welded box beam girder, one foot, six inches high by one foot wide. In turn, ten posts built up of 3/4-inch-thick stainless steel plate support the girder. "These were difficult to fabricate because, like the lobby and like the building itself, they are parallelogram in plan," said Ron Koenig of Allied Bronze. The posts are bolted together with socket head bolts, which were then welded and polished, forming a very tight, almost invisible seam. Between these posts are smaller posts, set on 5-foot centers, that act as mullions for the panels of glass, two balance doors, and three revolving doors.

Perhaps the most arresting security measure in the building, however, is a stainless steel and glass blast wall within the lobby that protects the elevator core. Fourteen feet high and 65 feet long, the blast wall is actually a glass box, one foot, four inches in depth and parallelogram in plan. The glass used on both faces is 7/8-inch-thick, acid-etched low iron glass, which is laminated with a special ionoplast interlayer originally designed to resist hurricanes in Florida. To enable the wall to withstand the required blast load, 25 posts of highly ductile bridge steel, ASTM A709 HPS 70W Grade, support the two-foot, six-inch-wide glass panels of the back face. These posts are bolted to four steel anchor rods, each 3/4 inch thick, which are affixed to the slab with epoxy. Alternately, the front face of the blast wall shows little support. Thirteen glass panels, 5-foot-wide by 14-foot-high, are supported at the floor by a continuous stainless steel base plate and at the top corners of the glass by four-inch-long stainless steel channel clips. There are no mullions and the gap between panels is only 1/8 inch. Stainless steel end plates, 3/8 inch thick, connect the two faces. All stainless used in the blast wall is Type 304.

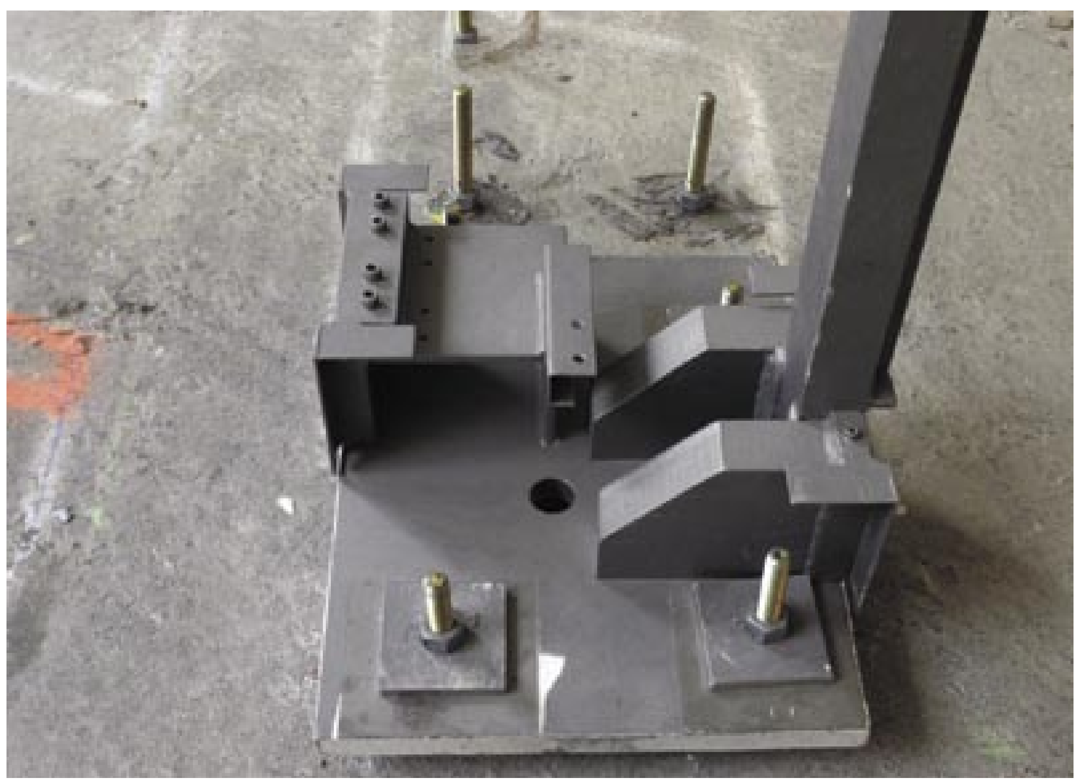
©DAVID SUNDBERG / ESTO



©DAVID SUNDBERG / ESTO

ABOVE Bolted connections anchor the stainless steel screens to the building's concrete exterior.

OPPOSITE The screens provide ventilation for a Con Edison substation.

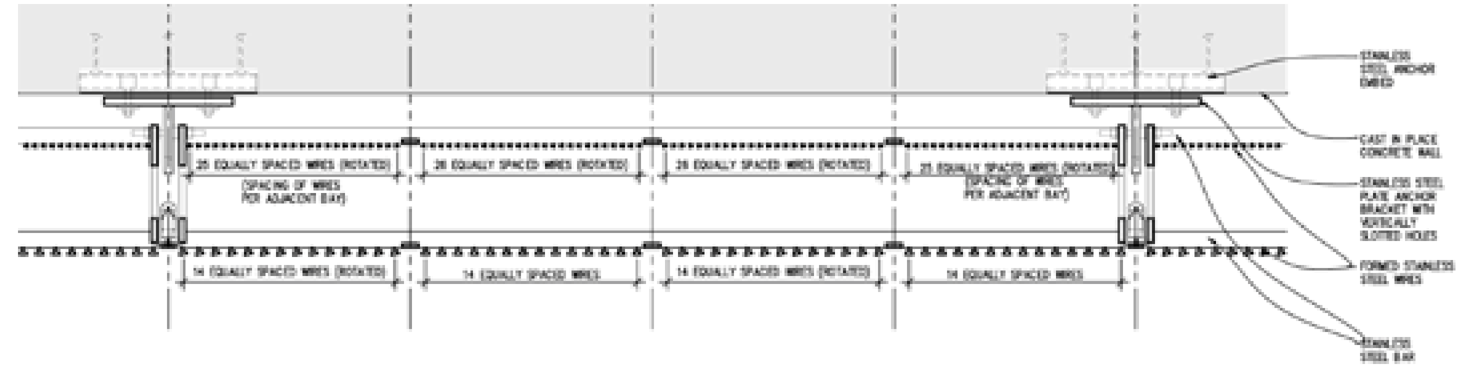


ALL THIS PAGE Highly ductile bridge steel was used for the anchors and supports of the lobby blast wall.

OPPOSITE Plan view of stainless steel screens

TOP LEFT ©2005 DANIEL BARBER, REST ©2005 DELILAH McKAVISH

COURTESY SKIDMORE, OWINGS & MERRILL



Additionally, the blast wall houses an LED lighting system. Five-foot-high words glow through the etched glass, displaying positive messages to the building's users.

The lobby features two other distinctive ornamental elements: the glass paneled ceiling and stainless steel column covers. Directly inside, six inches off the Cable Net Wall, are two concrete-filled, rolled steel structural columns. Covered in Type 316 stainless steel with a No. 6 directional long grain satin finish, the six-foot-six-inch-diameter columns rise 45 feet to the lobby ceiling. Assembled in three tiers, the covers, which have five sections of varying arc-lengths in plan, feature 1/16-inch seams.

Adjacent to the columns the ceiling drops vertically 15 feet and then continues horizontally 25 feet into the lobby. The entirety of this surface is paneled with 11/16-inch-thick acid-etched low-iron PVB laminated glass. The five-foot-on-center and two-foot, four-inch-wide glass panels are point supported by Type 316 stainless steel fittings at each corner and hinged for easy maintenance. Behind the glass is another light feature that illuminates the etched panels in a changing display of colored light.

Carpenter's solution for concealing the concrete substation was equally innovative: surround the concrete with a screen of triangular stainless steel rods, two rows deep and slightly offset, some 130,000 pieces in all. Carpenter said that the reflective qualities of stainless steel made it the obvious choice for the design. During the day the rods reflect sunlight, at night they emit a warm glow from more than 220,000 blue and white LEDs embedded in the assembly. The lights can pulsate according to a preset program, or, linked to cameras on the façade, can generate columns of blue on a white background that track pedestrians going by.

"This paneled system reinforces the overall concept of the facade being an ornamental system and a monolithic marker, which in turn reinforces the sharp-edged, crystal form of the building," said Carl Galioto, a partner at SOM.

There is an added advantage to the design as well, he said. "The screen permits the exterior wall to be permeable, and so it allows for the considerable flow of air necessary to cool the Con Ed transformers."

The rods were fabricated by Johnson Screens and erected by Permasteelisa. Using Type 316 stainless steel, the company built 15-foot-tall, five-foot-wide panels, each weighing 1,500 pounds. Bolted to the structure, these panels rise to the 6th floor. "The use of stainless steel on the base was important for several reasons," said Galioto. "First is overall appearance, the ability with stainless steel to maintain fine, crisp forms. But there is also the strength inherent in stainless steel and of course its weather resistance."

The building's two stairwells, formed of reinforced concrete, are fitted with steel handrails. Steel is the standard in this application, although the irregularities inherent in formed concrete stairs made fabrication and erection of the steel handrails a serious challenge. "You have to custom fit each flight of stairs," said Arthur Rubenstein, president of Skyline Steel, which fabricated and erected the handrails, as well as the steel used in the bathroom vanity mirrors. "Each one can be slightly different. You have a continuous handrail, but each part has to align perfectly."

When it is finished next year, 7 World Trade Center will stand as the first example of New York's ability to rebound from the September 11 attacks. And thanks to its myriad ornamental steel elements, it will make that stand all the more boldly. ■

7 WORLD TRADE CENTER

Owner **Silverstein Properties** *New York, NY*
Architect **Skidmore, Owings & Merrill** *New York, NY*
Engineers **WSP Cantor Seinuk** *New York, NY*
James Carpenter Associates *New York, NY*
Consultants **Israel Berger and Associates** *New York, NY*
General Contractor **Tishman Construction Corporation** *New York, NY*
Miscellaneous Steel Fabricator and Erector
Empire City Iron Works *Long Island, NY*
Skyline Steel Corp. *Brooklyn, NY*
Curtain Wall Fabricator and Erector **Permasteelisa** *Windsor, CT*
Cable Net Wall Fabricator **Josef Gartner Germany** *Gundelfingen, Germany*
Cable Net Wall Erector **Ment Bros. Iron Works** *New York, NY*
Architectural and Ornamental Fabricator **Allied Bronze LLC** *Long Island City, NY*
Architectural and Ornamental Erector
Ornamental Installation Specialists *Warwick, NY*
Metal Deck Erector **A.C. Associates** *Lyndhurst, NJ*