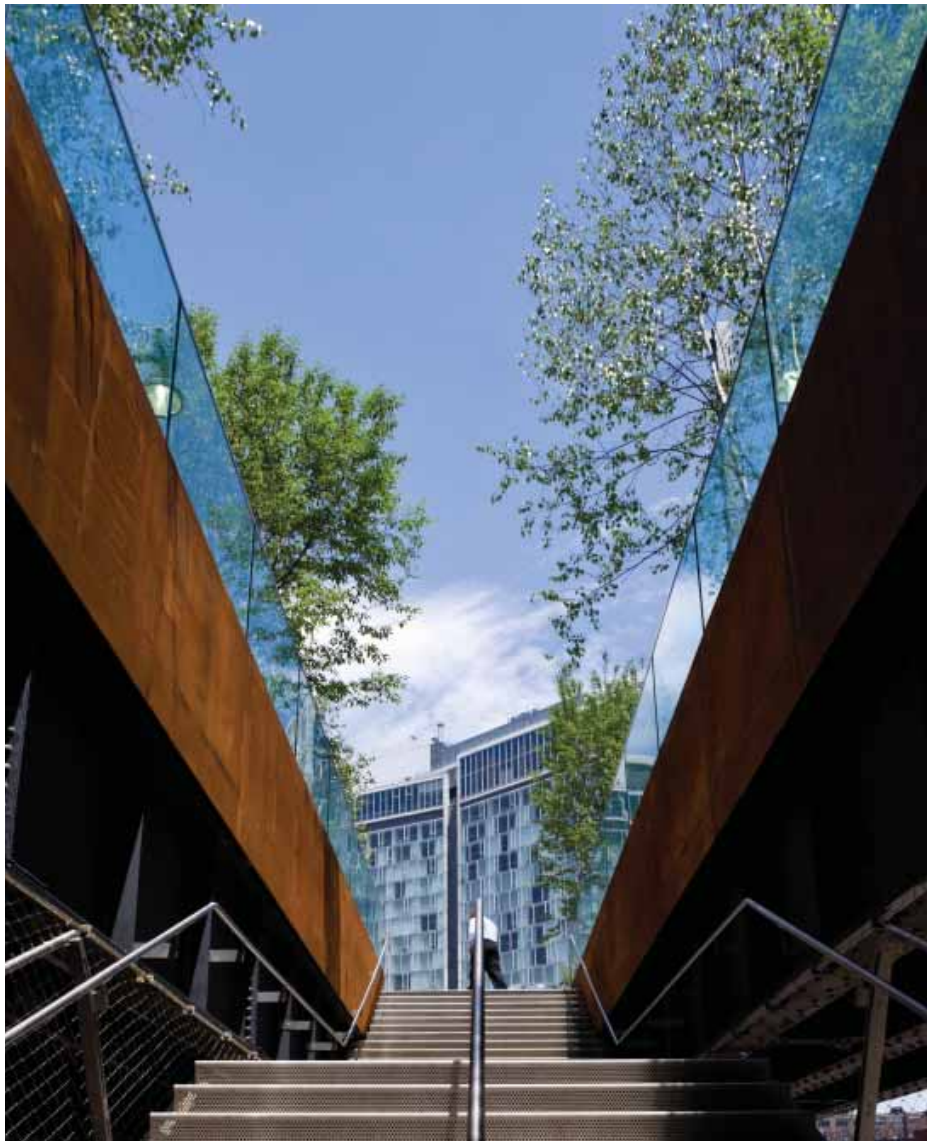


Facing The Gansevoort Slow Stair, at the corner of Gansevoort Street and Washington Street, looking north.

HIGH LINE

Elevated Reuse

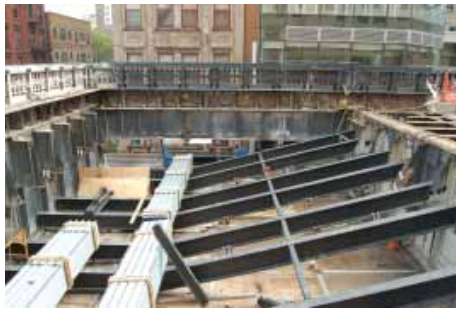
When the High Line was completed by the New York Central Railroad in 1934 so goods could be loaded and unloaded right inside factories that lined its route, its builders probably never fathomed it would see limited traffic as soon as the 1960s with the rise of interstate trucking. "The structure is just so massive, and so overbuilt," says Matthew Johnson, a senior associate at Diller Scofidio + Renfro. "They wanted it to last for 100 or 200 years." Nonprofit organization Friends of the High Line managed to save the massive West Side structure from threatened demolition, and then chose DS+R to transform it into a one-of-a-kind aerial park. Adding structural steel to the existing framework was integral to achieving the design vision because the firm wanted to play up the greenway's colossal steel underpinnings as much as possible. "It has so many layers," principal Ric Scofidio says, "it's like a French pastry."

Standing beneath the High Line, the rows of massive girders supporting the elevated tracks do somewhat resemble a slice of napoleon or baklava laid on its side. DS+R's objective was to celebrate the steel structure undergirding the entire park by revealing it wherever a patron entered. As a result, the main stairways at Gansevoort and 14th Street punch through these girders, like a fork carving a bite out of the pastry's center. This leaves the ornately riveted members that remain on either side clearly visible. Stan Wojnowski, an associate principal at structural engineer Buro Happold, said much of this work was made easier thanks to some incredibly detailed shop drawings that had been lying around the local office of CSX, the successor to New York Central. "Those drawings filled up three complete discs," Wojnowski says. "They were incredibly helpful with what we were doing."

At the Gansevoort entrance, the stairs cut straight up through the tracks, as the southern terminus of the park is located at midblock (though the tracks once ran two blocks further, to Jane Street). Because the tracks were highly reinforced to accommodate freight trains, the approximately 46-by12-foot-cut, which removed portions of the existing 7- to 10-foot-deep girders, did not compromise the area's structural stability at all. This was not the case, however, at the 14th Street entrance. There, because the stairs must rise up from the sidewalk and then make a 90-degree turn up and into the High Line, the 56-foot-long cut passed through one of the cross-bracing girders. This created a destabilizing arrangement in which a three-column girder became two smaller girders, one with two columns, and the other with one—Wojnowski compares this effect to that of a seesaw.

Because the park required elevator access for ADA compliance, among other reasons, the designers hit upon a brilliant solution wherein the elevator would do double duty, its structure serving as the second column of the destabilized girder. The first step, before the girder could be cut, was to support it with the elevator, which is made of ASTM A 500 tubes containing a glass-enclosed elevator, all of which was bolted to the existing structure. To further complicate matters, the connection occurs at one of the High Line's numerous expansion joints. The solution was to install a steel seat on the expansion side of the new concrete slab. Once this seat was in place, the cuts could be made for the stair just as they were at Gansevoort Street.

Due to its position above the roadway, the High Line's structural steel work had to be meticulously staged to minimize street closings—but nowhere more so than at the newly named 10th Avenue Square, the High Line's only major avenue crossing at 10th Avenue and 17th Street. Because the original columns could not be built in the middle of this busy intersection, the structure carrying the rail beds had to extend to the sidewalks, creating a diamond-shaped square amidst the generally slim, rectangular path of the tracks. The designers decided to take advantage of this unique point along the park to cut down into the girders and create 10th Avenue Square, an amphitheater that provides views of the avenue and the Hudson River.



Top and left: © Martin Perrin; far left: © Friends of the High Line

Top: Design by James Corner Field Operations and Diller Scofidio + Renfro. Courtesy of the City of New York. Bottom: © Friends of the High Line

Facing, top A stepped wooden ramp covering the steel structure allows park visitors to see the city from a unique vantage point.
Facing, far left Steel beams were fabricated to create a sunken seating area at the 10th Avenue Square.
Facing, left Structural engineers used a Vierendeel truss to allow viewing windows to be cut in the existing girder.

Top The 14th Street elevator provides the second column of a destabilized girder created by steel removal for the entrance's "slow stairs."
Below The Gansevoort Street entrance.

To support the amphitheater, eight beams fabricated in an obtuse L-shape were lifted into the cut-out portion of the square. The square's new viewing windows are another impressive example of the project's ironwork. Their design involved cutting holes into the existing girder to create a Vierendeel truss. "It's the most inefficient truss you can imagine, but it works, if mostly for aesthetic reasons," Wojnowski says. Because of its complexity, the erection crew from Kiska continually checked with Buro Happold to ensure the site would be safe and secure when the cuts were finally made—they would have only a one-day window to perform the work, lest traffic on 10th Avenue should be blocked any longer. "They kept asking us, 'Are you sure about the sequence? Are you sure about the loads?'" Wojnowski recalls.

Before the cuts could be made, the truss had to be reinforced. This was done with ASTM A36 plates and angles of varying sizes of 8 inches square by 1 inch, 8 inches square by ½ inch, 16⅜ inches square by 1 inch, and L8x6x1 and L8x4x½, all of which were welded to the existing steel. The reinforcing steel and welds were sized so as not to locally overstress the existing steel at the welding locations and all reinforcing steel was installed on one side only. Then came the cuts, three of them at 8 feet 5 inches by 5 feet 10¾ inches. Despite the contractors' fears of deflection, Wojnowski says the system worked just as planned, with the platform deflecting no more than ¼ inch.

"The idea from the start was to really celebrate this amazing piece of engineering," Johnson says. "We wanted to really play up what was there already." The result is a revived structure that subtly integrates new steel with the existing framework—a testament to both steel's flexibility and longevity. Were it not for the resiliency of the steel already in place, this outcome would have been nearly impossible. But even after decades of use and exposure followed by decades more of neglect, Wojnowski says the design team had almost no problems completing the project. "That's the beauty of steel, it just made the whole process easier." **M**

HIGH LINE

Location: **Gansevoort Street to 30th Street, New York, NY**
Owner: **City of New York**, New York, *NY*
Developer: **Friends of the High Line**, *New York, NY*
Architect: **Diller Scofidio + Renfro**, *New York, NY*
Structural Engineer: **Buro Happold**, *New York, NY*; **Robert Silman Associates**, *New York, NY*
Mechanical Engineer: **Buro Happold**, *New York, NY*
General Contractor: **KÍSKA Construction Corp.**, *New York, NY*
Structural Steel Erector: **KÍSKA Construction Corp.**, *New York, NY*
Miscellaneous Iron Erector: **KÍSKA Construction Corp.**, *New York, NY*
Architectural Metal Erector: **KÍSKA Construction Corp.**, *New York, NY*
Metal Deck Erector: **KÍSKA Construction Corp.**, *New York, NY*