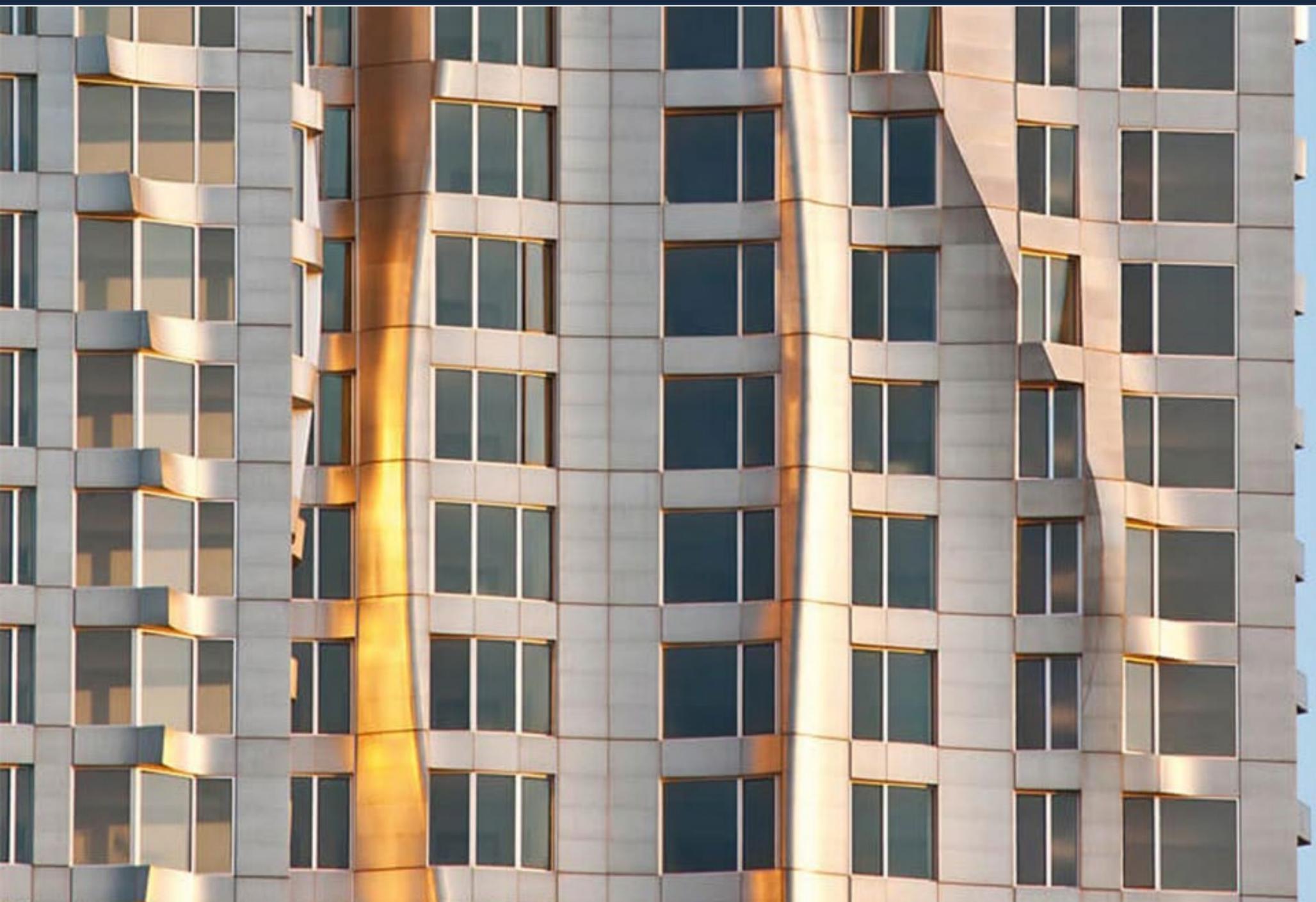


**FAÇADE IN FOCUS:**

EIGHT SPRUCE STREET, NEW YORK, USA

# Creating a free-moving façade



In Lower Manhattan, near City Hall and the Brooklyn Bridge and just a few blocks from the World Trade Center site, Eight Spruce Street rises high into the urban sky.

Completed in 2011, the building was one of the tallest residential towers in the world at 265m. Seventy storeys house over 900 luxury residential units, while the six-storey base of the tower is home to a school, offices, a residents' swimming pool and gym, and two internal public plazas. Stores open onto street level; garage space is located underground.

Keen to reinvent the classic Manhattan high-rise, developer Forest City Ratner Companies (FCRC) brought pioneering architect Frank Gehry on board to create Eight Spruce Street. Gehry designed the tower from the inside out, to make the most of residents' views over the city. As a result, Eight Spruce Street offers an unrivalled panorama, unimpeded by any nearby skyscrapers, with a T-shaped plan that allows for apartments with six different orientations.



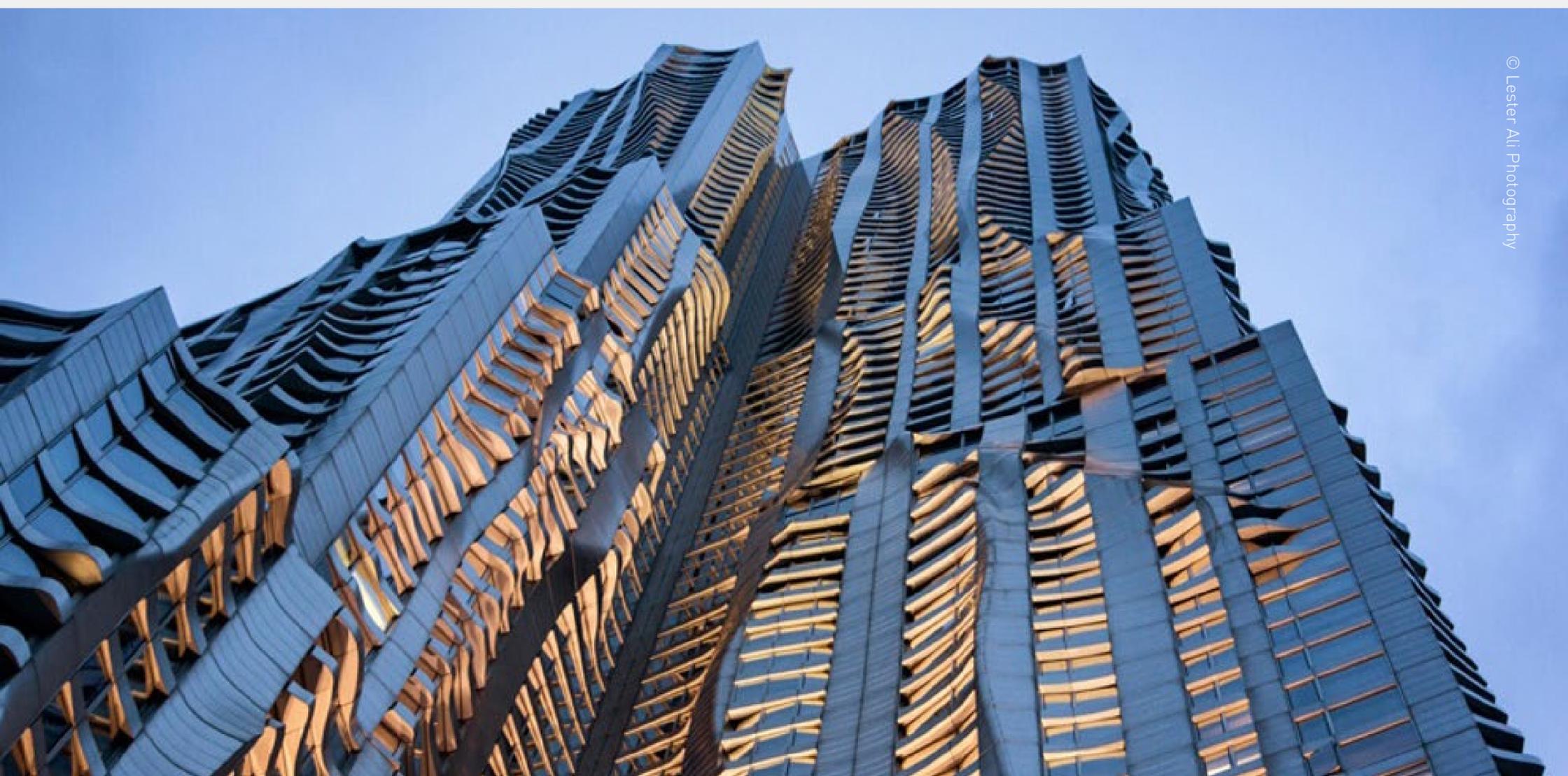
In its form, materials and functions, the building's brick base fits in with the surrounding urban fabric. The tower itself, however, stands out as a steel and glass monument on the skyline, with floors offset from one another to create a soft series of waves that envelop the building.

## **GIVING FORM TO THE FAÇADE**

One of the starting points for Gehry's remarkable façade design for Eight Spruce Street was the traditional New York bay window:

“What I wanted to do was to resurrect the bay window... When you walk to a window that's flat, you're there and you can see on either side of the window; but if there's a bay window you walk two more feet forward and you're in an outer space, so that the window surrounds you. And that experience on the 40th, 50th, 60th floor is unique. There's nothing like it in New York.”

**Frank Gehry, Gehry Partners**



Gehry developed the concept of a free-moving façade to accommodate the bay windows. Rather than aligning the windows vertically, he moved them slightly from floor to floor, adjusting their size from unit to unit. Having made studies of this, Gehry realised that it had the look of fabric draping over the building, and developed the design to accentuate this effect.

Seven sides of the tower have this configuration, while the south side is sheared into a flat plane that contrasts with the curvature of the other façades and strengthens the sculptural effect.

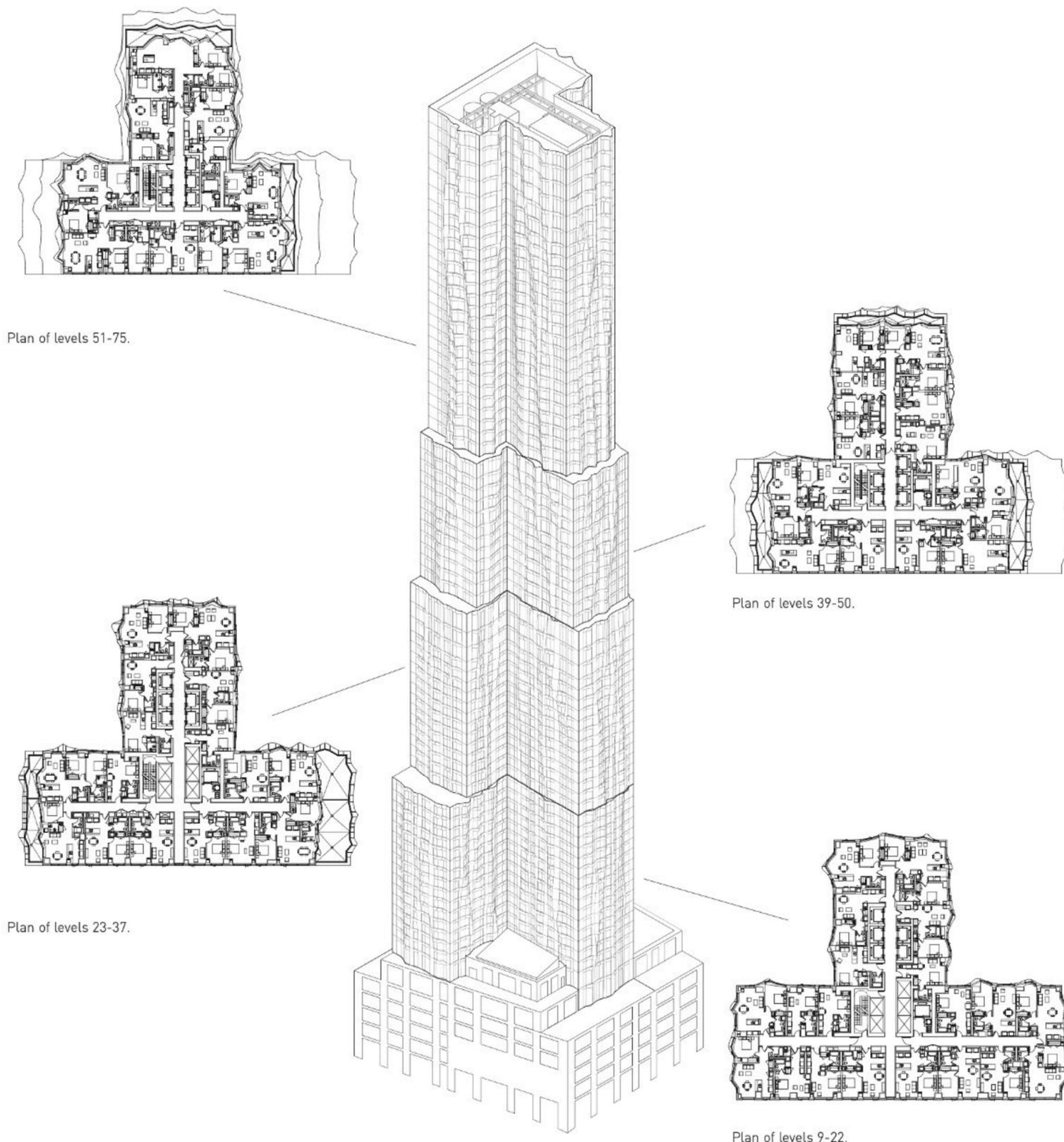
Starting from the proportions typical of New York skyscrapers, the team at Gehry Partners developed the façade's form through a design process that spanned paper and 3D design. In total around seventy 3D models were created to different scales, based on which the surface areas and geometries of the façade were defined.



“It is a kind of inside out, outside in, they both drive one another.”

**John Bowers, Gehry Partners**

Permasteelisa Group was brought in to translate Gehry's façade design into reality, with a design assist stage that lasted for over two years. During this time designers from Permasteelisa North America and Gehry Partners worked together to establish a series of principles for developing the curved components of the façade. These had to reflect the apartment layout, which varies from floor to floor.



The apparent freedom of Gehry's façade design is actually the result of a meticulously accurate study of form, size and curve, which made it possible to assemble the structure of individual elements that suggest a surface in free movement.

“We analysed the façade and, through the collaboration efforts with PermaSteelisa's team, were able to really truly understand all the different geometries and conditions that we needed to resolve and to come to grips with in the final details.”

**John Bowers, Gehry Partners**

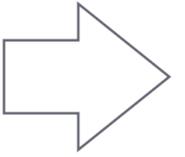


## **DESIGN AND ENGINEERING: CREATING THE CURVES**

The decision was made to manufacture the façade using a unitised system, requiring the design of the envelope surface to be broken down into single panels. After investigating how to curve the surface area, the team decided to follow a cold folding approach, exploiting the metal's natural flexibility. Mechanical folding of the panels was only used for portions of the façade with a particularly broad curvature radius.

Finite element analysis was used to reduce the free-form shapes of Gehry's architecture into single curvatures. Using information from the team at PermaSteelisa North America, Gehry Partners refined the shapes so that more than 90% of the cladding surface featured a single curvature, making adjustments to optimise manufacturing.

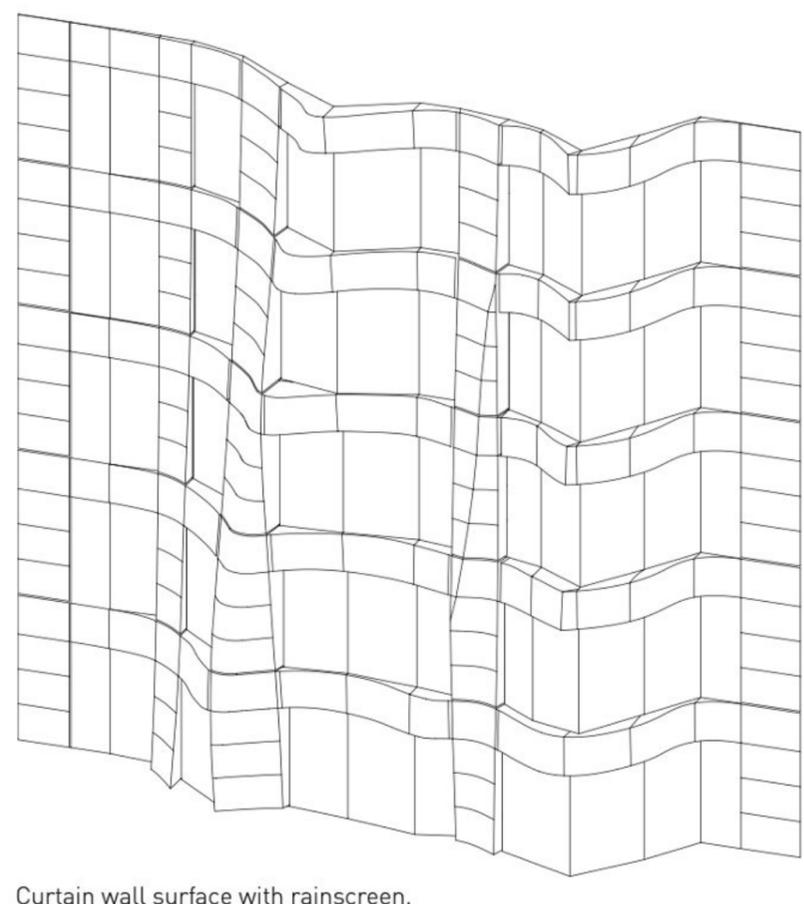
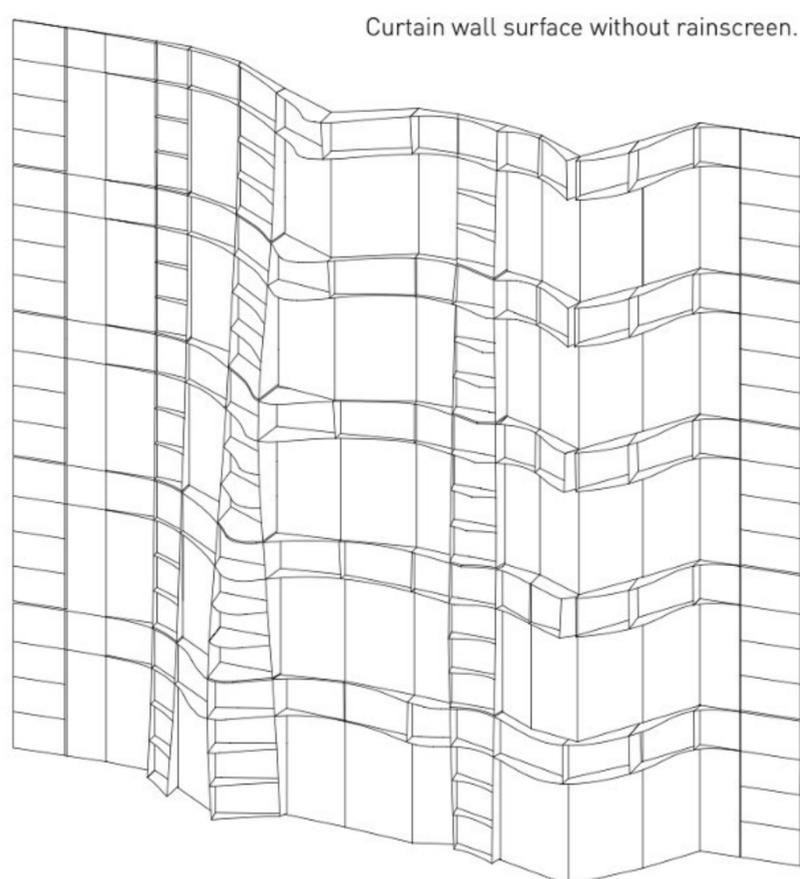


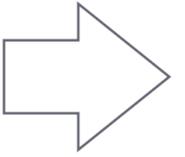


The iterative process to define the parametric function took a huge amount of work, including the resolution of more than 10,000 requests for information (RFIs). This paved the way for the solution that proved to be key to the project's success: dividing the building envelope into two fundamental pieces:

- an internal skeleton made from unitised curtain wall panels – this constitutes the façade's protective barrier against air and water
- an outer metal rainscreen made out of stainless steel panels applied to the curtain wall.

This design made it possible to carry out the segmentation envisaged in the architectural design. By separating the internal air/water barrier and the external metal cladding, it was possible to engineer and manufacture the components separately as unitised units.

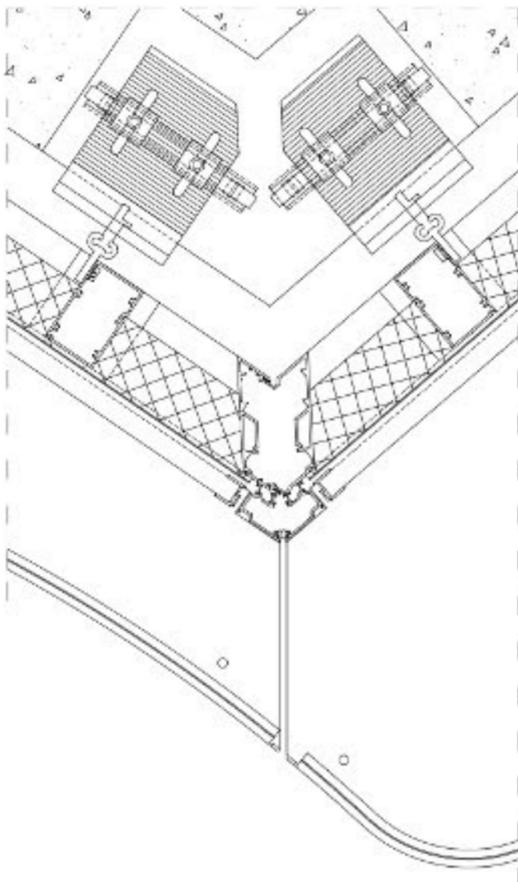




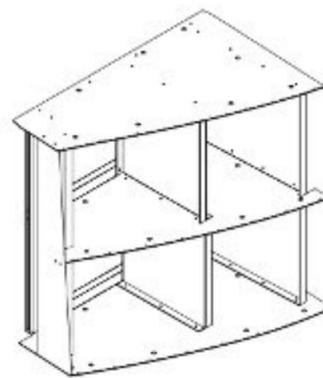
## DESIGN AND ENGINEERING: SHAPING THE PANELS

The internal portion of the façade was made from insulated glass and aluminium unitised panels. These are planar on the interior surface and segmented to follow the superstructure's profile. The floor-to-ceiling windows are all made of flat glass, although the overall movement of the façade gives the impression that the glazed areas follow a curved design.

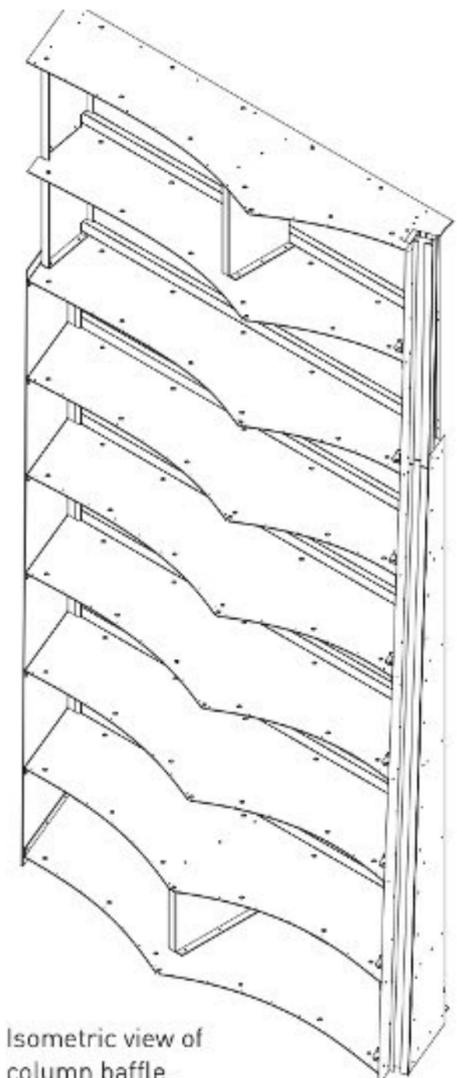
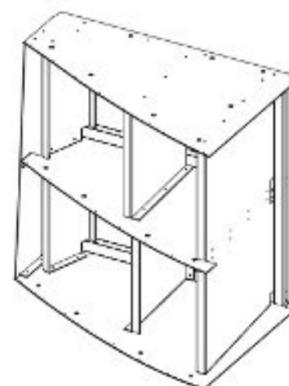
For the columns and spandrel areas, outer rainscreen assemblies are made of formed stainless steel sheets attached to ribbed aluminium substructures. The initial design stage had identified two basic forms for the unmistakable curved steel sheet cladding: a knife edge and a cylinder along with a flat unit. These two shapes create the geometry of the building.



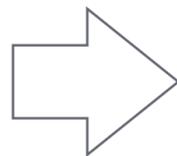
Façade anchor  
horizontal section.



Isometric views of  
spandrel box assembly.



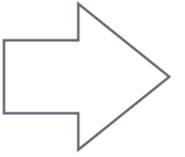
Isometric view of  
column baffle.



All panels have interlocking male-female mullions and a mating horizontal stack. They also have anchoring clips that attach conventionally to embeds in the segmented edge slabs. The internal structure's vertical mullions were designed as 'families', allowing the architect to envision the design and positioning of the glazed surfaces and bay windows by taking a segmentation approach.

Each floor of the tower has a different configuration, with the glass plane offset from the theoretical wall plane. As a result, a unit's gutter may be offset in or out from the unit below by nearly 1.5m. To help achieve this, the PermaSteelisa team researched and designed an innovative two-piece gutter system that follows the line of the façade units above and below, to compensate for the offsets.

The final architectural envelope spans a total of 40,000 sqm. Different on every floor, the unit-based steel and glass skin required the design and engineering of 10,911 rectangular panels, of which just 1,900 are exactly the same. A total of 3,746 cladding units were made to create the stunning stainless steel contours, 1,568 of which are curved and 2,178 flat. The 3m high units vary between 1.07m and 2.3m in width.



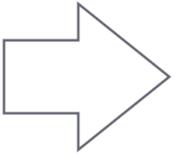
## MANUFACTURING AND INSTALLATION

The manufacture of approximately 11,000 façade units took place at PermaSteelisa Group plants across North America and Canada. During the manufacturing stage, the steel sheet panels were specially treated to obtain a fine pattern, with an angel hair-type finish to soften the high reflectivity of standard grain finishes and avoid a dazzling effect.

Because the site was in a densely built-up area, with little space for materials storage, co-ordinating deliveries was a major challenge for the project management team. PermaSteelisa North America developed software to track the installation and mounting of individual façade components, ascertaining which assemblies needed to be installed together and defining the exact positioning of each panel's façade. The 3D models created during the design stage enabled the installation team to use the anchoring systems with optimal precision and verify that the individual panels were correctly positioned.

The optimisation of the cladding engineering from the outset meant that each level of Eight Spruce Street was completed in four or five consecutive working days.





## **AN EVER-CHANGING FEATURE**

In the urban spaces of Lower Manhattan, which in recent years have witnessed much growth and many changes, Eight Spruce Street still rises as a surprising, ever-changing feature on the skyline.

With such distinctive architecture, the surface area of the façade is never the same, capturing and reflecting light to provide an image that is always new to residents and visitors alike. For people fortunate enough to live in such an incredible space, able to see far into the distance from a number of different angles, Eight Spruce Street is almost like flying over New York.



This issue of Façade in Focus is adapted from the book Complexity and Eternal Beauty, published by PermaSteelisa Group in 2017.

## PROJECT CREDITS

**Owner & developer:** Forest City Ratner Companies (FCRC)

**Architect:** Gehry Partners, LLP

**Contractor:** Kreisler Borg Florman General Construction Company

