Fulton Center
Structure

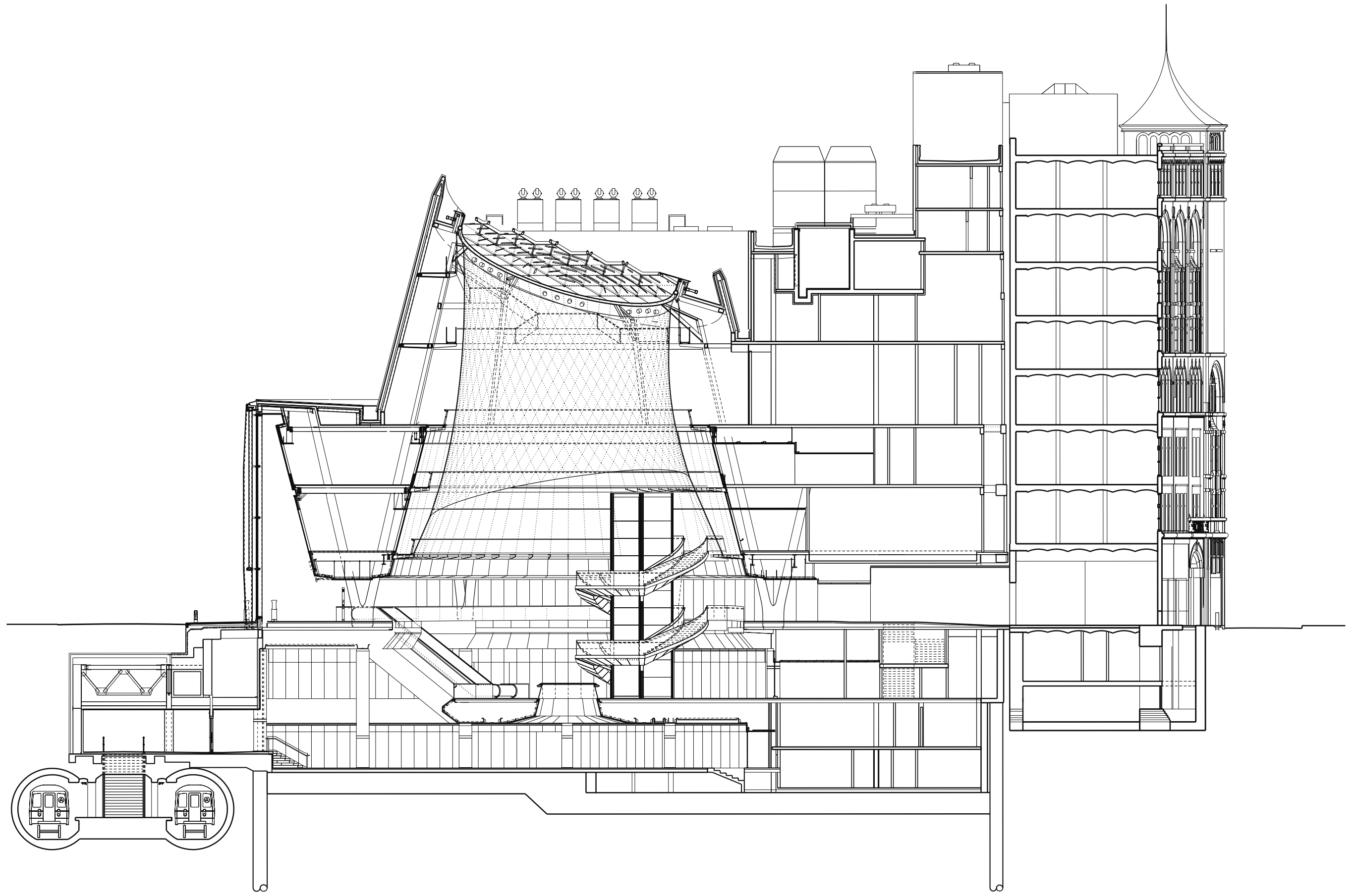
New York City's subway system is a wonder of the world—which most riders take for granted. At the new Fulton Center in Lower Manhattan, a single escalator ride can remind even the most jaded urbanites of the marvel at their service.

FROM JOHN STREET, VISITORS CAN enter the Fulton Center pavilion via the Romanesque Revival–style Corbin Building. There, they reach a concourse underneath Broadway via a 30-degree wellway that cuts a section through the basement and sub-basement of the 125-year-old building, revealing inverted masonry arches that distribute superstructure loads more evenly. Commenting recently in *The Guardian*, Jimmy Stamp wrote that the escalator journey makes available to the public a "beauty of construction that can be found nowhere else. This short descent makes you feel the weight of the building and realize the incredible feat of engineering that is the New York City subway."

Adapted as an extension of the Fulton Center pavilion, the Corbin Building contributes multiple meanings to the wider project. The eight-story landmark is an aesthetic foil to the Grimshaw design next door. Once widely known as the "father of the skyscraper," the building also preserves Lower Manhattan's complex urban fabric. And, designed by Francis Hatch Kimball for Long Island Rail Road president Austin Corbin, the building helps the Fulton Center capture the full spectrum of New York's transportation history.

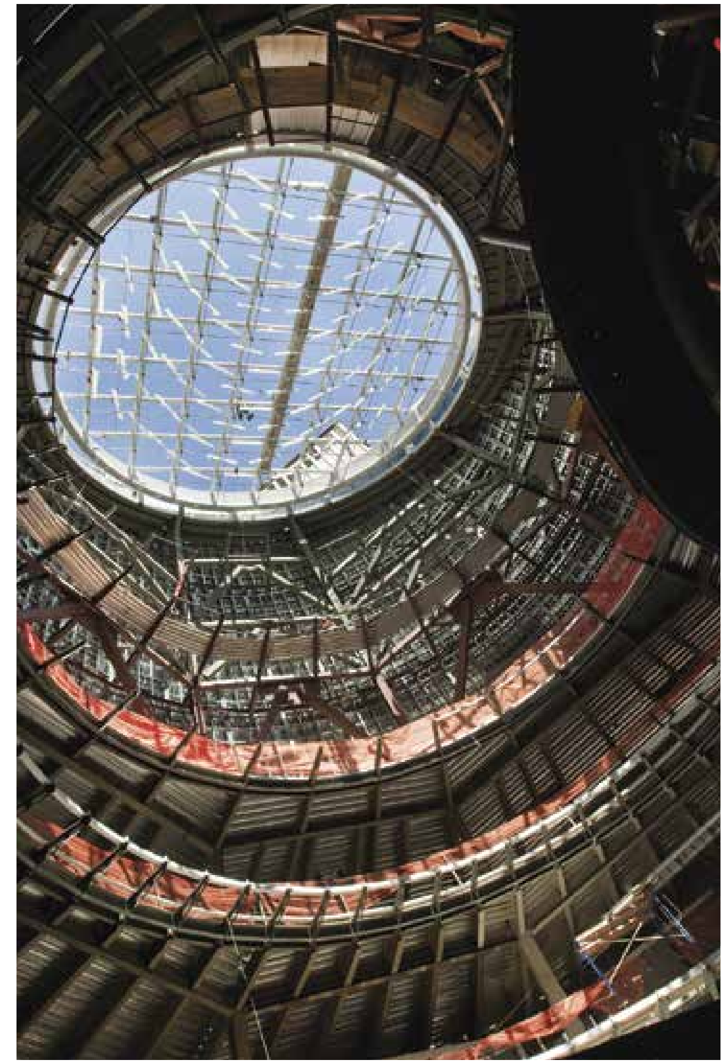
Yet initial plans for the Fulton Center had targeted the Corbin Building for teardown.

In 2003 MTA Capital Construction appointed Arup as prime consultant for the Fulton Center, and the multidisciplinary engineering firm hired Page Ayres Cowley Architects to document the Corbin Building prior to demolition. This research disinterred rich memory from underneath years of neglect, which contributed to the proto-skyscraper's addition to the National Register of Historic Places later that year.



Above A section of the Fulton Center and the adjacent Corbin Building.
Left An interstitial building ties the Fulton Center to the historic Corbin structure.

This spread photographs: MTA/Patrick Cashin; diagram: Arup; opening spread: James Ewing



Above left Within the pavilion, the outer branches of V columns support the pavilion roof, while the inner branches support the oculus and frame the center's dome.
Above right A circulating stair connects the center's shopping and dining venues.

Grimshaw and Arup's scheme for the overall Fulton Center was revised, to save the high-rise. In order to fully integrate into the transit node, the Corbin Building would perform as the southern entrance to the Fulton Center and include the plunging escalator, among other functions. Allocating those roles to the structure meant first updating it to current codes and standards, says Arup principal Craig Covil, noting, "When the Corbin Building was designed 125 years ago, the New York building code did not have chapters concerning seismic nor wind loading."

The Corbin Building forms a 152-foot-long narrow wedge shape whose major axis runs north to south, and which measures 40 feet at its widest point. Structurally, it comprises a gravity frame of cast-iron columns and wrought-iron beams supporting Guastavino tile-arch floors. While columns are embedded within the building envelope, the facade is self-supporting masonry, with self-supporting cast-iron bay windows on the south and west elevations.

Unreinforced masonry is the source of lateral stability in a historical building like the Corbin tower, and due to the 20-foot width of the west elevation, as well as its abundant fenestration, Arup identified this side of the building as a particular weak spot for lateral load. It also found that the new functions required of the Corbin Building's adaptive reuse could compromise the structure further. In a 3-dimensional ETABS model, for example, Arup demonstrated that penetrating the north elevation to link to Fulton Center new construction overstressed the masonry. The escalator wellway—the realization of which would require removal of parts of the street and two basement levels, all within liquefiable soils—also posed adverse effects to the south masonry retaining wall.

To resist north–south loading, the Arup team decided to link the Corbin Building's destiny to the new construction. Instead of creating lateral load structure within a small historic footprint, it ties levels 2 and 3 of the Corbin Building to the Fulton Center via an interstitial building. Set back slightly from the Broadway street wall, the interstitial building features a structural steel grid of wide-flange steel sections consistent with ASTM A992 standards rising the full height of the Corbin Building. Covil refers to the seemingly separate volume as a "splint."

During construction, steel integrity ties consisting of 8-by-4-inch double angles were installed in a north-south direction between opposing piers. These angles were required to resolve the lateral thrust of the inverted arch foundations during ex-

cavation of the adjacent lot. In preparation for the transit center's construction, engineers underpinned the western end of the building. These portions are supported on reinforced concrete walls cast beneath the existing shallow foundation.

For additional support, Arup applied a seismic upgrade technique to the north-elevation masonry between datum and level 2. Crews encased the wall in 4 inches of reinforced shotcrete and attached it to the existing masonry via L-shaped reinforcing bars in a 2-by-2-foot grid. To stiffen the Corbin Building above level 3, a concrete moment frame distributes lateral loads to the Fulton Center ties below, and connects to the interstitial building directly in accordance with system modeled after springs.

Arup produced these solutions in tandem with its development of the escalator void. To realize it, the project team followed a similar principle of transferring the southern retaining wall's loads to the newly constructed floor diaphragms to the north. Now, steel and concrete act as a horizontal beam over the wellway, connecting the Corbin and interstitial building to one another at street level.

At the basement and sub-basement levels, moreover, a massive ring beam was placed within the escalator insertion, and aligned to the Fulton Center structure. A new concrete retaining wall moves load from the south retaining wall into the ring. Crews undertook the process of creating this wall over the course of more than a year, first by underpinning the new element with concrete needle beams and excavating the so-called Bull's Liver soil, then creating the retaining wall and the profiled concrete wellway itself.

When the Corbin Building earned historic status, and project stakeholders signed a memorandum of understanding to integrate the landmark into the overall Fulton Center, the design team had already developed a full-block new-construction scheme for the project. Even though the sudden change of course scrapped three months of work, Covil recalls being pleased with the decision "because preserving the Corbin Building is the right thing to do," he says. "It added significantly to our work, because we had to revisit a lot of assumptions, but that process helped our thinking."

Indeed, the interstitial building performs many other tasks, chief among them buttressing the Fulton Center pavilion in addition to the Corbin Building. The pavilion's structural grid is tied to the more robust middle structure so that, as Covil says, "Those three components are all effectively one building." (Unlike the multivalent interventions found beneath the Corbin Building, the interstitial and pavilion buildings are rooted to structural columns on 25-foot centers, which rise from a concrete raft.) In what Covil calls "a mixture of compromise and optimization," the interstitial building also shoulders egress, ConEd transformers, freight elevators, and a conduit for main electrical equipment, all of which benefit the entire headhouse facility.

The most visible of all of the maneuvers required to bring Fulton Center to life is within the pavilion, where V columns comprised of wide flange column sections rise to support the second and third floors of the "donut" surrounding the central atrium. The outer branch of each V column terminates at the pavilion roof, while the inner branch rises to support the oculus, and frame the dome beneath. Moment connections between gravity columns and primary girders provide additional lateral stability and general redundancy.

As passengers stream through the transit hub, they may be unaware of the feat of engineering that has brought them here. ☐

Above Arup demonstrated the construction's feasibility with a 3-dimensional ETABS model.
Facing The interstitial building under construction at the northeast corner of John Street and Broadway. When the Corbin earned historic status, the design team revisited initial plans for full-block development.

This page: MTA/Patrick Cashin; Facing page: James Ewing

FULTON CENTER STRUCTURE

Location: **Fulton at Broadway and Cortland Street, New York, NY**
Owner: **MTA Arts for Transit and Urban Design and the MTA Capital Construction Company (MTACC)**, *New York, NY*
Sky-Reflector Net Artist: **James Carpenter Design Associates (JCDA)**, *New York, NY*
Architect: **Grimshaw Architects**, *New York, NY*
Structural and Mechanical Engineer, Facade Consultant: **Arup**, *New York, NY*
Construction Manager: **Lend Lease**, part of a joint venture with **PB Americas**, *New York, NY*
Structural Steel Erector: **Imperial Iron Works**, *Bronx, NY*
Architectural Metal Erector: **Jordan Panel Systems Corp.** (exterior/interior metal panels), *East Northport, NY*
Ornamental Metal Erector: **Capco Steel Erection Co.**, *Providence, RI*
Curtain Wall Fabricator and Erector: **Enclos**, *New York, NY*