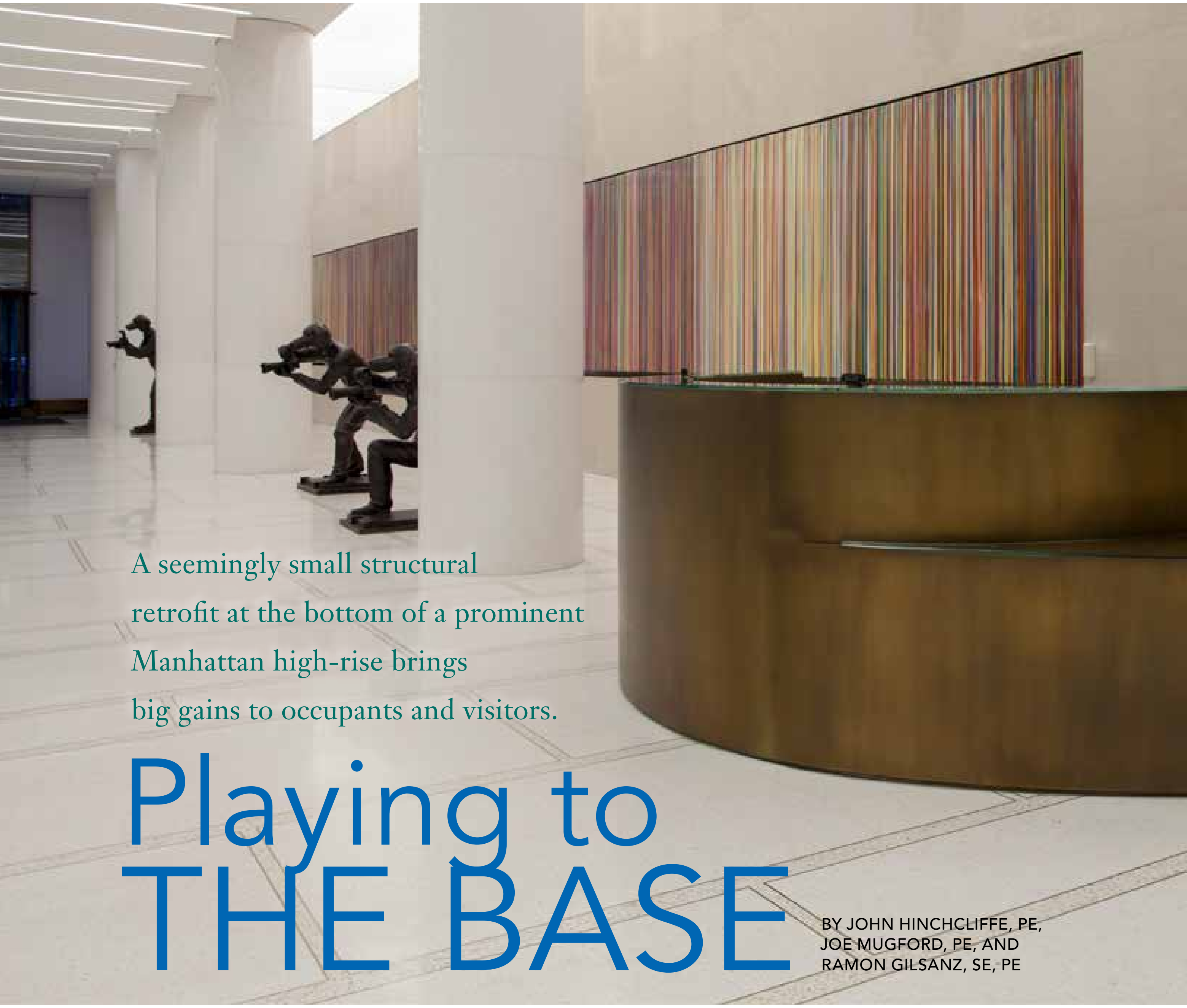

A seemingly small structural retrofit at the bottom of a prominent Manhattan high-rise brings big gains to occupants and visitors.

Playing to THE BASE

BY JOHN HINCHCLIFFE, PE, JOE MUGFORD, PE, AND RAMON GILSANZ, SE, PE

75 ROCKEFELLER PLAZA LOOKS down on one of the most famous public spaces in a city of famous public spaces.

New ownership recently undertook a full renovation of the landmarked building, and a reimagined lobby now helps extend Rockefeller Center's pedestrian thoroughfare up to 52nd Street. As part of the renovation, the building's façade was restored, the existing elevators were replaced and extended, the existing mechanical systems were replaced and multiple new roof terraces were created to upgrade the tower's office floors. A new storefront with bronze mullions and monolithic glass panels invokes the building's original architectural style.

To aggrandize the new thoroughfare, four existing tower columns were removed from the double-height lobby. Three of these columns supported existing transfer girders at the second floor. Each column, carrying between 1,700 and 2,700 kips of service gravity load, was part of the building's lateral system (a steel moment frame with partially restrained connections). The building was designed under New York City's 1938 building code, which specified a much smaller lateral loading than modern design standards like ASCE-7. As such, careful attention was paid to the effects of the new load path on the existing lateral elements, and the overall stiffness of the lateral system was maintained.

Multistory trusses and the removal of each column from the top down were among several schemes that were considered for removing the columns before the design team decided to use new transfer girders below the second-floor framing. The new transfer girders run parallel to the existing transfer girders and effectively extend their span to the next column line. The new girders needed to fit below the second-floor slab, around the existing built-up transfer girder and

▲ The newly renovated lobby of 75 Rockefeller Plaza.

▲ The 33-story, steel-framed building totals 623,000 sq. ft.

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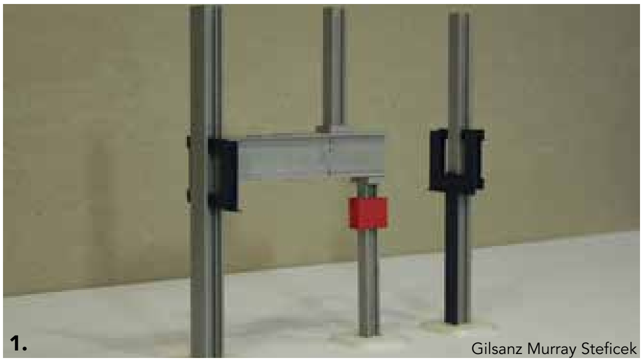
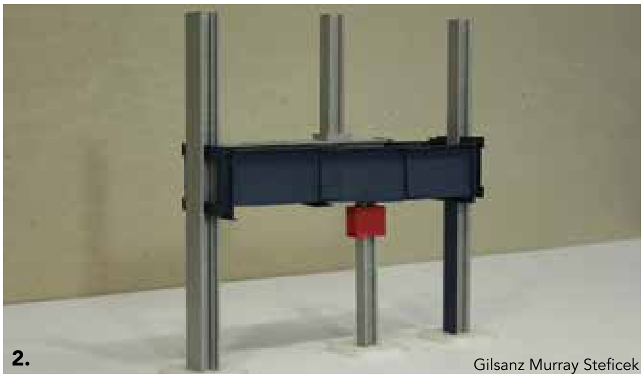
Courtesy of KPF

A 3D model printed as individual elements, in stages. 1. Column reinforcement and connection plates installed. 2. Half of each box girder installed on each side of existing column. 3. Installation of jacks and load-transfer plates. 4. Column below is ready to cut.



1. Gilsanz Murray Steficek



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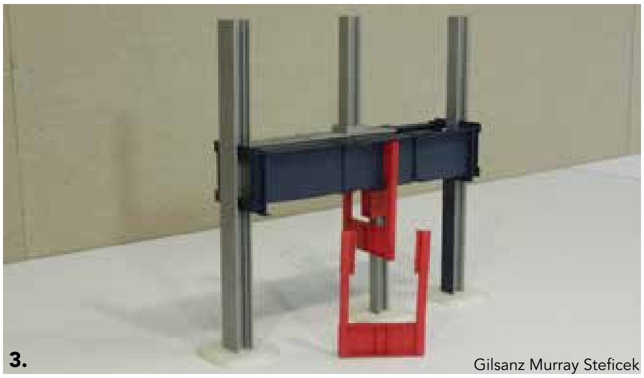
above and between the scalloped architectural finishes of the new lobby ceiling. To meet these requirements, composite box girders were used for the cross section of each new transfer. The box shape could be kept tight to the existing transfer girders and within the envelope of the new ceiling. Engaging the slab to develop composite behavior helped minimize the depth and tonnage of each member. The elastic section of the steel shape was designed for the dead load, reduced live load and anticipated load that would be induced from the column jacking. The plastic section of the composite shape was designed for the unreduced live load, providing some reserve capacity.

Each new girder was connected to the end of the existing transfer girder with a diaphragm plate that spanned between the webs of the new girder. The existing columns that are part of the new load path were reinforced with single-sided cover

Courtesy of KPF

▲ The new lobby space features white walls and terrazzo floors.

◄ The box girders were jacked at the four columns to be removed.



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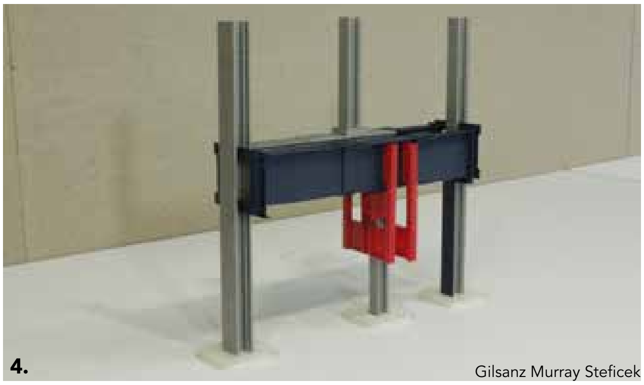

4. Gilsanz Murray Steficek

plates from the second floor down to the existing grillage foundations. The plates were widened where they meet the webs of each new transfer girder to allow for the new shear connections to be made. *Strength and Ductility Requirements for Simple Shear Connections Under Shear and Axial Load* by William Thornton was referenced when analyzing moment transfer through the new girder connections. As box girders are more common to bridges than buildings, the American Association of State Highway and Transportation Officials (AASHTO) *Specification* was consulted during design in conjunction with the *Specification for Structural Steel Buildings* (ANSI/AISC 360, available at **www.aisc.org/specifications**).

The engineer worked closely with the steel fabricator while developing erection and preloading procedures for the new transfers. A scaled 3D model was created—printed as individual elements and attached via magnets—to help commu-

▲ ▼ ➤ The composite box girder scheme coordinated well with the planned sculpted lobby ceiling, which required the transfers to be as narrow as possible.

▼ Hoisting a new girder in two segments to surround the existing framing.

▼ Box girders, in place.

Courtesy of Gilsanz Murray Steficek

Courtesy of KPF

The new lobby entrance.

75 Rockefeller Plaza, under construction seven decades ago.

Courtesy of Gilsanz Murray Steficek

The original building was completed in 1947.

nicate the design concept to the team and the owner. Each girder was fabricated and transported in six pieces that were spliced together in the field and erected into place.

The girders were preloaded to minimize deflection of the existing column above, as well as to minimize any load that would be induced into the existing moment frame as a result of this deflection. Each girder was loaded using two temporary steel yolks that were connected to the webs of the new girder at the location of the existing column to be removed. Jacks were installed between the yolks and the existing column to be removed. The new girders were then pulled down against the column to be removed, which was pushed up. Effects encountered during the preloading, such as axial shortening and resistance from the steel moment frame above, were considered in the structural design and loading procedure. The process was monitored from the initial loading through the final connection and column removal. This was critical for a successful transfer, as the magnitude of the load and the extent of the existing column elongation meant a visual separation was not achieved prior to cutting the existing column.

The newly revitalized tower maintains its historic elegance while providing modern-day amenities and spaces. Thanks to an innovative steel solution, its updated lobby provides an enhanced ability to welcome visitors to one of the city's most high-profile plazas. ■

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Steel Fabricator and Detailer
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Steel Erector
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