From the Top

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Closed for two decades, Rockefeller Center's observation deck is given new life and reopens to the public, thanks to the flexibility of the existing steel structure.

FOR MORE THAN SEVENTY YEARS, ROCKEFELLER CENTER HAS BEEN A CENTER OF COMMERCE, ENTERTAINMENT, AND TOURISM FOR NEW YORK CITY. Although the complex's most well-known building, the 70-story GE Building (also known as "The Rock"), was originally built with an observation deck at the top, tourists have be restricted to the lower floors of the building since the deck's closure more than twenty years ago.

Last year, however, the Top of the Rock project reopened the observation deck and expanded it with features beginning below ground and extending to the highest points of the building. The lower portion of the project includes a three-story atrium at street level, wrapped with a double-level curved stair cantilevering from the side walls; and a mezzanine level featuring a complex of exhibits and a theater conveying a history of Rockefeller Center, including a "beam walk," where a visitor can walk across a virtual steel beam in an exhibit that simulates the working conditions of an iron worker high above the streets of New York.

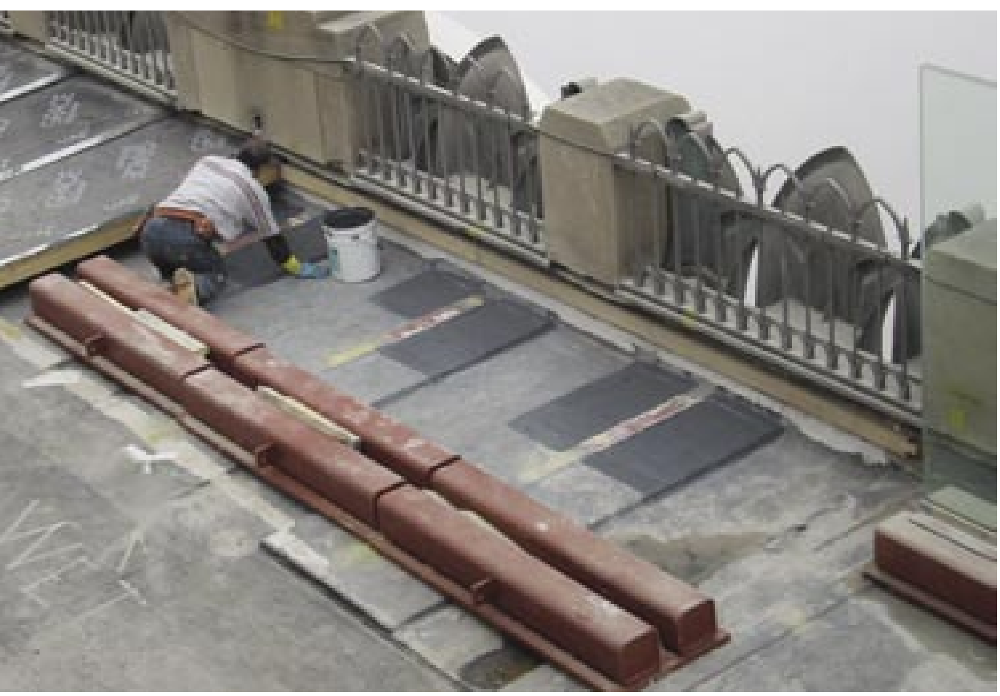
At the top portion of the project, accessible via elevator, visitors are received in a lobby area at the 67th floor that is surrounded by views of New York on three sides. This area also includes the first of three levels of outdoor terraces, which provide an open-air view of the city's skyline. Additional outdoor decks are provided at 69th and 70th floors. Escalators speed the movement of visitors between the levels, and shuttle elevators are also available.

Starting with the Top...

The design of the project needed to be sensitive to the difficulties of altering a 70-year-old structure—while fully occupied and without disturbing the tenants. Clearly, the structural material was a major consideration. Axis Design Group, structural engineer for the project, chose structural steel framing for multiple reasons. It provided the ability to easily connect to the existing structural steel framing and it could be transported the top of the project in sections, readily spliced on-site, and erected over existing equipment. As such, steel shapes were used to reinforce existing beams, as well as for the design and erection of steel trusses.

When it came to renovating the upper portion of the project, it was determined that the alterations would be conducted without an exterior derrick or crane. Instead, all construction material was brought up via existing freight elevators—including the

All construction materials were brought to the top of the building using the existing freight elevators.



8″ square HSS attached to structural framing below the roof support the 8½ ft tall glass wall panels, just visible to the extreme right in the photo.

structural steel. In addition, four elevators needed to be expanded upward to provide service to the 67th floor. This required extending the elevator shafts and raising the elevator motors up higher within the building. The bulk of the 68th floor framing was removed in order to create a spacious public space at the 67th floor level, and two new escalators were to be added to connect the 67th floor with the 69th floor.

For the elevator extensions, all motors and equipment had to be supported at the 69th floor level. This required support to be provided for more than 100,000 lb of reaction for each elevator motor. Further, the location for the elevator extensions formerly housed a water tank, which needed to be reconfigured. With four elevators and the water tank sharing this area, over a half-million lb of new loads needed to be supported at the 69th floor level. The members supporting these loads were also supporting the exterior façade walls of the building. In addition, the length of each piece of steel reinforcement was limited to 10 ft due to the size of the elevator cabs.

With these considerations in mind, the new framing for the support of the elevator reactions consisted of two new trusses between the 69th and 70th floors. Each truss used the existing framing of the 69th floor and 70th floor levels for the chords of the trusses. This method resulted in an enormous savings to the project, since it kept the existing roof floor and façade of the building intact. Further, by utilizing 12-ft-deep trusses, the forces in the chords were much lower than would have been required for a plate girder. Each truss was configured as a hybrid of Warren and Vierendeel configurations due to space restrictions. Truss connections were made by welding gusset plates to the chords. The floor beams were utilized for the chords of the trusses and were reinforced for the heavy loads.

In order to build the new elevator machine rooms, the existing water tank had to be removed, calling for the installation of a temporary water tank on steel dunnage above the roof. Structural steel was used for the temporary dunnage framing above the high roof to support an outdoor water tank. After the new tank was installed, the temporary tank was removed and the temporary dunnage was moved to other parts of the project and reused. This provided cost savings by reducing the amounts of both old material that needed to be removed and new material to be brought in.

Two escalators were constructed between the 67th and 69th floors. At the base of each escalator, pits were constructed directly above the Rainbow Room restaurant, with the requirement that the restaurant not be disturbed at all for the duration the project. These parameters were met using structural steel for the support of the escalators and for the construction of the framing. In order to keep clear of the tenant, the bottom of each escalator had to be raised above the original floor level. Maintaining a level floor throughout this public space was achieved by raising the entire floor and creating a floating floor above the original floor. This was accomplished by capitalizing on reserve capacity within the original steel framing, so reinforcement of this portion of the existing structure wasn't necessary. This system provided increased acoustic isolation from the Rainbow Room below.

For the outdoor portion of the project, glass wall panels were provided above the roof at each of the three roof terraces. Each panel was 8½ ft high and cantilevered without any visible or exposed framing. Structural steel was used to support the panels, which involved a pair of 8-in. square HSS that were attached to support beams buried below the roof. This system was designed so that the glass panels could resist the hurricane-force winds present at the top of the building.

Back inside the building, the majority of the existing elevator machine room on the 69th floor needed to be removed in order to create the 67th floor public space. To accomplish this, the existing machinery from support framing was re-supported by means of a combination of hangars and posts to the 67th and the 69th floors. This required reinforcing the steel framing in multiple locations by adding WT sections to the existing beams, and some of the reinforcement needed to be added within existing operating elevator shafts. However, access within the operating elevator shafts was limited to a few hours each night so as not to disturb building tenants during the day. Structural steel proved to be the right material for the reinforcement by virtue of its quick installation and its ability to be easily welded to the existing steel beams.

Access for the installation of the elevator machinery supports was complicated by the presence of an existing mechanical plant at the 66th floor level. Sequencing of the work required that the steel reinforcement be installed in sections over the period of a year. But the existing elevator equipment had to provide service to the building during this entire period, during which mechanical equipment and services were reconstructed. Temporary support of the operating elevators was achieved with a series of hangers and posts to distribute the machine loads temporarily throughout the construction site.

Back at the Bottom…

The new atrium was carved through the ground floor and mezzanine levels of the building. The atrium opening is immediately adjacent to the exterior wall and the foundation wall. In order to create this opening, lateral loads from the foundation wall needed to be transferred around the atrium opening. Structural steel was employed together with a reinforced concrete floor slab to act as a horizontal beam to transfer the loads at the ground floor level.

The atrium's stairway was designed using structural steel cantilevered from the back walls of the atrium. Steel hangers were inserted behind the atrium walls below the third floor to support the stairs. The stairs were designed with a very shallow profile to cantilever from the back wall, and the architectural intent was to have a thin shell so that the stairs would "float" within the atrium. The stairway was constructed within the open atrium space using steel framing, working from the top of the atrium down to the bottom. This process was a reversal of the normal construction procedure, but was employed in order to accelerate completion of the ceiling and roof above the atrium.

Steel was used not only to support the stairs, but also for the stairs themselves. In order to accelerate the schedule, the entire stairway was pre-assembled and test-fitted at the fabrication shop to determine the as-built dimensions for finishes prior to on-site erection.

The new elevators in the atrium were carved into tenant spaces and service spaces at the elevator over-runs and pits. Space below the elevator pit floor was limited two in. (the pit itself is 4 ft deep). For the pit floor, the design team used a steel plate, which was installed at the level of the bottom flanges of the supporting beams. At the intermediate floors and at the machine room, extremely tight spaces required that the counterweights be placed between the guide beams, in the same space as the cables. Steel tubes were used to brace the elevators, so shaft space didn't need to be increased.

Space and Time

The Top of the Rock project required the very close interaction of the design team. Excellent cooperation, communication, and teamwork among the consultants were the keys to the successful completion of this $70,000,000 project. And the use of structural steel was crucial in maintaining the needed flexibility and for working within the very tight parameters of space and time. MSC

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The ground floor lobby staircase features a very thin profile. The stair was pre-assembled and test-fitted at the fabrication shop to determine the as-built dimensions for finishes prior to on-site erection.