

Located in a scenic but difficult-to-access site on the East River in Manhattan, Rockefeller University's new lab facility incorporated modular construction delivered by barges to come together piece by massive piece.

# Barging IN

BY AINE M. BRAZIL, PE

NYC Constructors/Banker

**ROCKEFELLER UNIVERSITY** is in a tight spot.

Founded by John D. Rockefeller and widely considered one of the best biomedical research institutions in the world, the university is located on Manhattan's Upper East side, adjacent to the East River and FDR Drive, one of the city's busiest roadways and a major north-south traffic artery.

When the university decided to expand its campus with a modern three-story building to house laboratory space, it was boxed in on the north, south and west sides. The only way to go was east—over FDR Drive.

The new 180,000-sq.-ft building has laboratory space on two floors and will offer researchers a place to work and connect on the same floor, with the proper resources to pursue their projects. The layout encourages collaboration across disciplines and allows for maximum flexibility in rearranging current laboratory spaces. Two one-story glass pavilions are located atop the laboratories and provide office and cafeteria space, as well as a plaza with greenery and outdoor seating. Slated for completion next year, the building will house the university's research programs in genetics, neuroscience, biological imaging, cancer biology and other fields.



- ▲ A completed rendering view from Roosevelt Island.
- ▼ Framing for one of the pop-up assemblies on the roof level.



- ▲ Framing for the amphitheater.
- ▲ The Chesapeake 1000 crane, ready for the first pick.
- ▶ A rendering of the completed roof, showing the amphitheater.

When constructing a laboratory of any kind, special care must be taken to eliminate vibrations that would affect the daily activity of the lab, such as footfalls inside or rumbling vehicles outside, and long spans like those employed for this expansion are typically more susceptible to vibration issues. Understanding that standard rules frequently employed for vibration analysis would not be adequate for this project, project structural engineer Thornton Tomasetti approached the design by performing detailed dynamic analyses of the overall structure and tuned the sizes to satisfy the vibration limits required for a laboratory.

**Aine M. Brazil** is vice chairman of Thornton Tomasetti.





▲ The amphitheater faces the existing, adjacent building.

▼ Lay-down space was between FDR Drive and the river promenade.



### Over the Drive

Not only did the expansion need to meet vehicle clearance constraints on FDR Drive, it also had to match current campus elevations for connections back to existing buildings. Thus, construction depth needed to be minimized. The design called for columns along the east side of FDR Drive to be spaced at 96 ft on center. These two-story “Y” columns are founded on pile caps with multiple mini-piles rather than large caissons due to limited capacity for equipment on the esplanade. Columns on the west side of the roadway are spaced

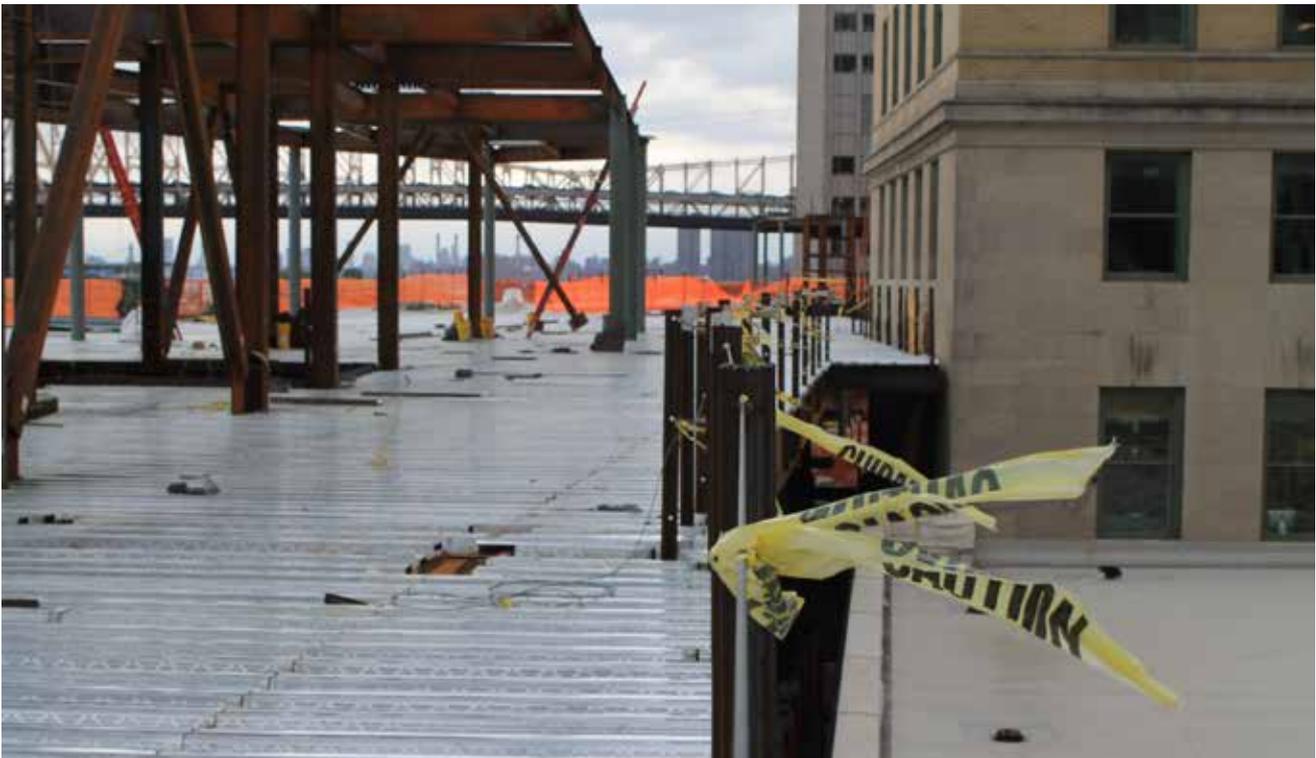
at 48 ft on center. The primary superstructure consists of two levels of high-strength plate girders, each approximately 5 ft deep, spanning up to 92 ft over FDR Drive. The girders are linked by diagonals such that they can act together like a truss; this assembly also supports the green roof on the third level. In addition, the 900-ft long building was laterally supported at two mechanical and electrical rooms (located at modules 7 and 10) with drag struts (two at each of these rooms) that were embedded in the first-floor slab and welded to plates cast into the shear walls of the mechanical rooms.



Photo: Thomas McLane, Thornton Tomasetti

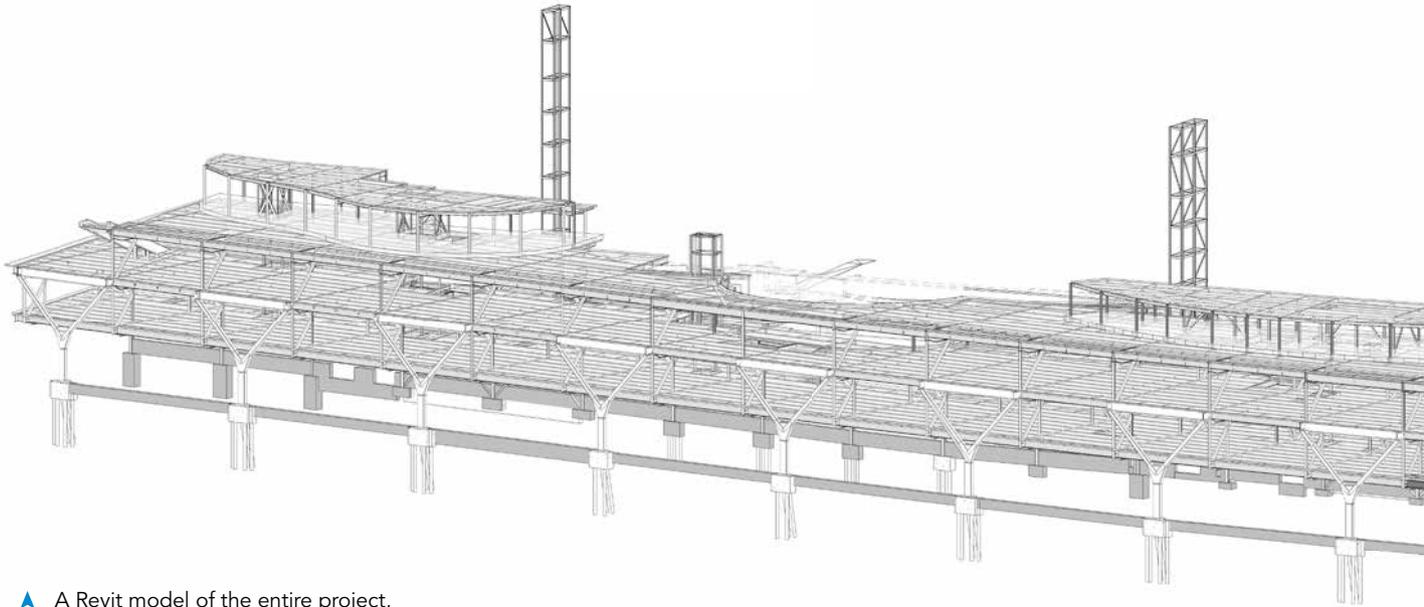
▲ One of the plate girders being assembled off-site.

▼ The modules were set 2 in. from the existing structure.



Working on and over one of the busiest highways in New York City could have been an excessively expensive and time-consuming endeavor. In addition, laydown area for the job was limited to a 10-ft to 15-ft strip of land between FDR Drive and the river promenade. In an attempt to reduce the cost and schedule and address these space constraints, the design and construction team explored off-site modularization for the structural framing system. Fabricator Banker Steel further developed this plan and came up with the solution to split the building portion that would span FDR Drive

into 19 individual modules—approximately 92 ft by 48 ft and three levels high. These modules were prefabricated on a site in New Jersey and transported to the site via barge. Several other trade components were also installed into the modules prior to shipping, including cast-in-place concrete on two levels, fireproofing sprinkler systems and conduits. The modules were set 2 in. from the existing structure, the façade of which was surveyed using a point cloud survey and incorporated into the 3D model of the new building at the design stage.



▲ A Revit model of the entire project, produced by Thornton Tomasetti.

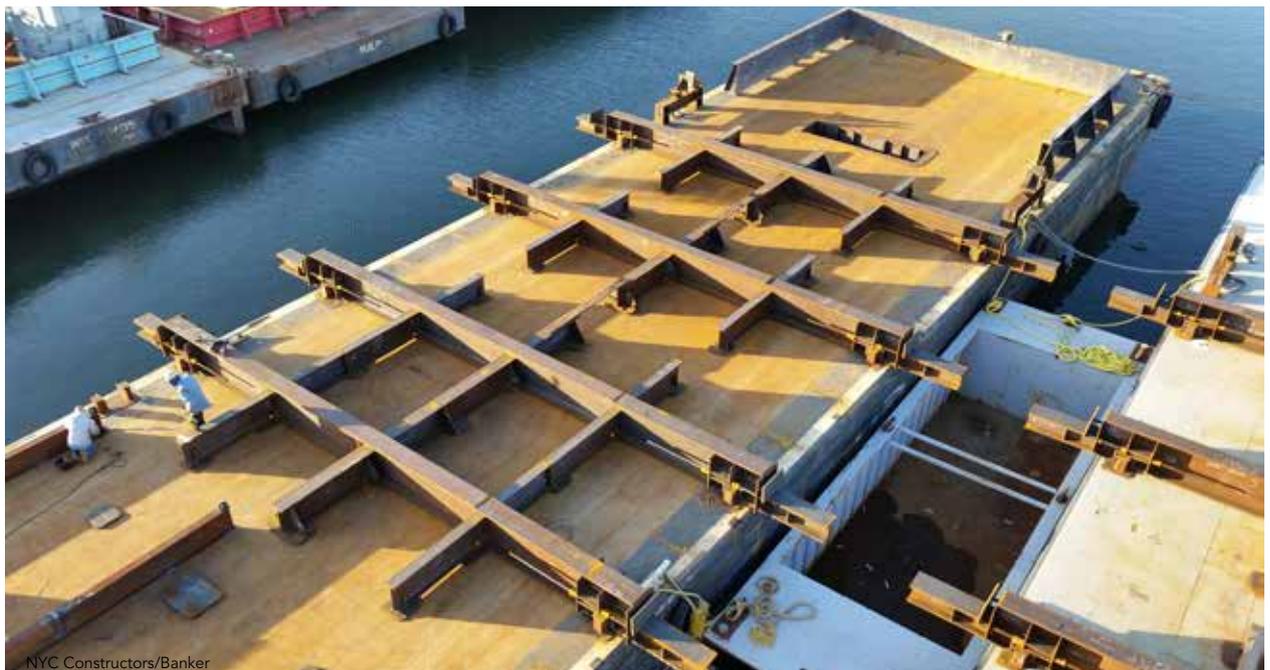
### Modification for Modules

As the modules for Rockefeller University were assembled some 20 miles southwest of the job site in Keasbey, N.J., they had to be barged to the site. However, the barges that were employed weren't built specifically for such a job, so the construction team worked with the barges' owner to modify the vessels, with the promise that they would be returned to their original state following installation of the 19 modules.

The transformation involved removing cargo walls at the perimeter of the barge—known as “coaming”—and adding transverse beams to transfer the loads imposed back to the center of the barge. They also had to be modified to include a “pocket” for the Y-columns to sit in, so as to avoid the need to raise the module up so it

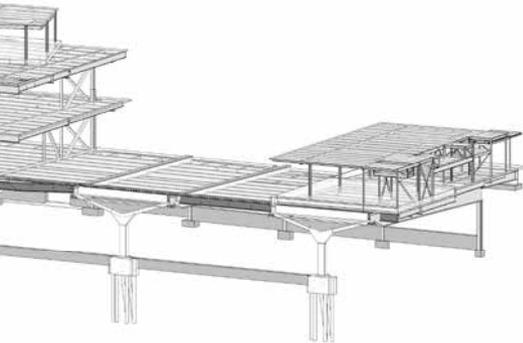
would clear the deck—which would also raise the loaded barge's center of center of gravity and increase the risk of overturning. In addition, stair towers on 30-ft track beams were added to provide ironworker access for connecting the lift frame to the modules.

Modifications also had to be made to the Chesapeake 1000 barge crane. A mooring arm, which pivoted off the corner of the barge, had to be installed. While setting the modules at the site, this mooring arm connected to a 120-ft-long whaler beam (connected to two Y-column shafts) which provided horizontal stability and a rotation point for the barge when it had to rotate approximately 90° from pick position, taking the module off the transport barge to its final placement on the building site.



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- ▶ The Chesapeake 1000 crane preparing to erect the first module.



Each module was lifted and installed from the barge during 19 separate five-hour periods during a two-and-a-half-month span in the summer of 2016. The lifts were performed via the Chesapeake 1000, a rare, 1,000-ton barge crane. The crane was only able to operate during a steady slack tide, and FDR Drive closures were limited to 12:00 a.m.–5:00 a.m. in order to minimize traffic disruption, so there were specific days on which the lifts could take place. In the end, this modular construction and erection scheme shaved several months off the original schedule and minimized on-site steel erection.

Constructing the building over FDR Drive was one of the project's major challenges, as the roadway needed to remain open with limited disruption to the traffic flow and minimal impact on the city. The project team also had to ensure the safety of the passenger cars that drove through the site each day on FDR Drive.

### In and Around the Modules

Following installation of the main three-story modules, smaller but equally important framing assemblies have been taking shape on the site in and around the modules while using the modules themselves as lay-down area. The modules are split into two, alternating types: main modules and infill modules. The main modules incorporate the east-west spanning plate girders that the north-south beams connected to—e.g., module 2 (infill) contained north-south spanning beams that connected to the north plate girder on module 1



- ▶ Picking one of the Y-columns.
- ▼ A module in transit under the Garden State Parkway en route to Manhattan.





Lorenzo Sanjuan, Thornton Tomasetti

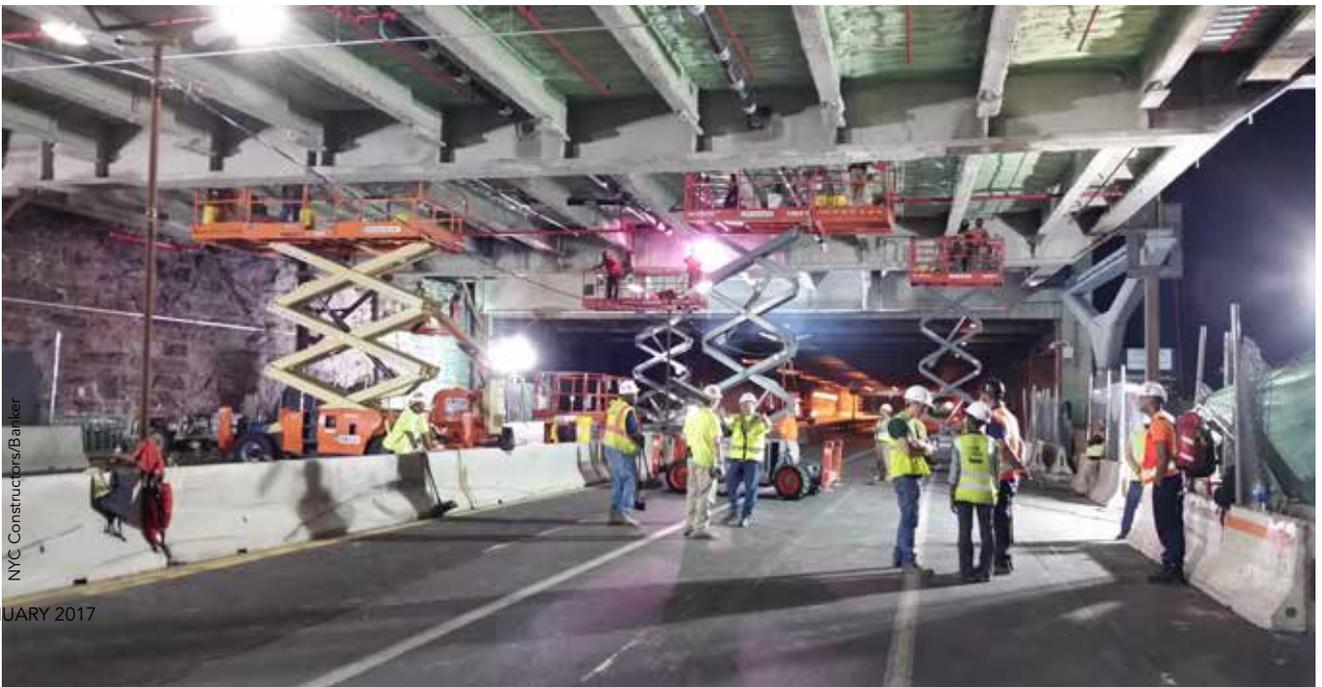


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- ▲ Placing Module 1.
- ▼ A view of the mooring arm at the site (the red steel).



- ▲ Loading a module onto the barge.
- ▼ Work being performed underneath the project, on FDR Drive.



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(main) and the south plate girder on module 3 (also main). These beams required temporary steel to hold them in place from the time the modules were separated in New Jersey until they were connected to adjacent modules at the job site.

On top of the modules, near both ends of the building, are level-four steel-framed “pop-up” assemblies that serve as mechanical space and roof access. The steel members for these assemblies were loaded on top of the modules in the assembly yard in New Jersey and stick-built using a 15-ton-capacity crane that was hoisted from the street after the third module was set. The crane sat on top of crane mats that spanned the level 3 floor steel; concrete for this level was poured on site due to weight restrictions on the barge.

The project also features somewhat of a contrast to the pop-up assemblies in the form of a rooftop amphitheater, which is sunken into the structure and faces the existing, adjacent building. The outrigger steel for the amphitheater was erected as part of the modules, with some of the minor beams between the cantilevers-out-riggers erected by the 15-ton where it was connected to two modules. The gap in the third floor in the modules where the amphitheater resides created additional work in terms of installing the modules; since there was effectively no third floor to attach to in these areas, the rigging had to be attached to the second-floor plate girders.

Thanks to a combination of off-site assembly, modular thinking and barge delivery, the framing for Rockefeller University’s new expansion made the most of the small space it had to work with on the edge of the Upper East Side—and in doing so will give its occupants a larger space to expand their research. ■

**Owner/Client**

Rockefeller University, New York

**General Contractor**

Turner Construction, New York

**Architect**

Rafael Viñoly Architects, New York

**Structural Engineer**

Thornton Tomasetti, New York

**Steel Team**

**Fabricator**

Banker Steel Company,  Lynchburg, Va.

**Erector**

NYCC, Inc.  (a Banker Steel Company), New York

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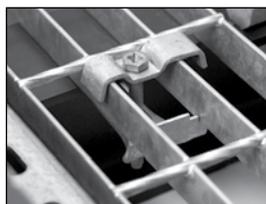
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