

An economical all-structural-steel gravity and lateral framing system is the perfect solution for this residential mixed-use project.



Philadelphia FREEDOM

BY CHRISTOPHER
GOTTSCHALL

THE FIRST PHASE of Philadelphia's East Market development topped out last November, defying local convention with its all-steel gravity and lateral framing systems and no concrete core. Located on the corner of 11th and Market Street, the 220-ft-tall, 400,000 sq. ft tower uses 3,500 tons of structural steel to frame one level of below-grade parking and two floors of retail topped with 15 floors of luxury apartments.

Other structural systems were considered during the schematic phase of the project, but steel framing was the winner, as it allowed for flexible retail layouts and provided economical floor-to-floor heights in the apartment tower by incorporating plank-on-steel construction.

One Grid

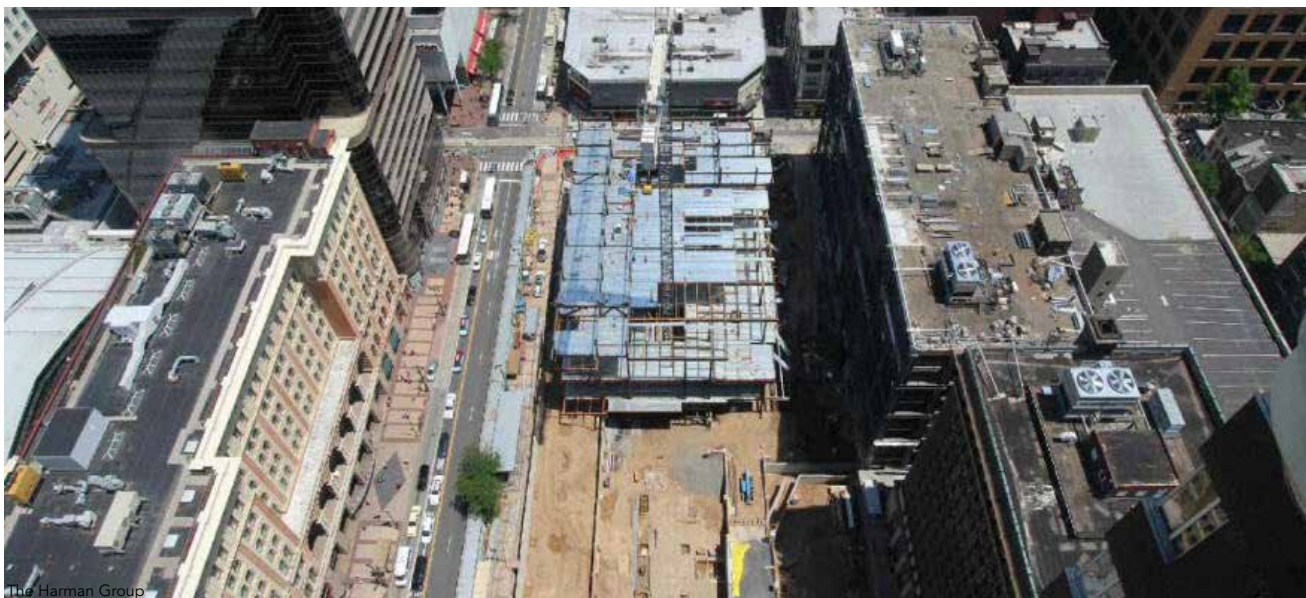
The first structural challenge to tackle with any mixed-use facility is the column grid. Ideally, one column grid would serve the needs of the parking, retail and residential uses without transferring columns, as structural transfer levels are typically cost-prohibitive in the Philadelphia market. Given that, the design team worked out a single column grid that accommodated all three building uses. For layered, mixed-use projects like East Market, The Harman Group's structural engineers achieve the best results by laying out the column grid to accommodate the parking circulation plan and then moving up to the residential and retail levels. Working with the architect, BLT Architects,



Courtesy of BLT Architects

◀ The building consists of two floors of retail space, 15 floors of apartments and one level of below-grade parking.

▲ The East Market development is expected to help revitalize a section of Market Street in Philadelphia's city center.



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the structural team conducted several parking plan iterations to evaluate the effects of different column layouts on the retail and residential spaces.

The team eventually settled on a 27 ft, 6 in. square base grid, which provided 24-ft-wide drive aisles as required by Philadelphia's building code and allowed for three parking spots in each bay. This grid also allowed for flexibility in the retail spaces. Columns were then shifted slightly off-grid as required to accommodate the architecture of the apartment tower. As a result of close team coordination at the beginning of the project, only two tower columns had to be transferred above the parking level, thus minimizing costs.

▲ The project is on a busy thoroughfare just two blocks east of Philadelphia's famed City Hall building.

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- ▲ The project uses a combination of concentric and eccentric braced frames in the “sail” direction of each leg of the L-shaped building.
- ◀ Phase one of the project uses 3,500 tons of steel to create a 220-ft-tall, 400,000-sq.-ft building.
- ▼ A column grid of 27 ft, 6 in. by 27 ft, 6 in. was used in the below-grade parking level and continues through the retail levels, then the columns shift slightly off-grid to accommodate the architecture of the apartment tower above.

Lateral Transfer

Selecting a lateral force resisting system for the phase one building posed a more significant challenge. Because the apartment tower is an L-shaped structure, each leg required bracing in both directions. The team used a combination of concentric and eccentric braced frames in the “sail” direction of each leg of the L and moment frames in the perpendicular direction of each leg. This project is somewhat unique for Philadelphia, as steel-framed buildings of this size and height would typically have a concrete core.

Below, the retail podium is braced entirely with concentric braced frames. Because of the high floor-to-floor heights in the podium, it wasn't finan-

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cially feasible to continue the moment frames in the tower down through the retail spaces. In addition, the retail and parking layouts could not accept braced frames in the same locations as in the apartment tower. The design team employed a lateral transfer level at the podium/tower interface to shift the lateral system from the tower into the podium. The lateral force transfer was achieved through a reinforced concrete diaphragm, as well as a series of drag struts, taking the lateral loads out of the moment frames and braced frames in the tower and shifting them into the concentric braced frames of the retail podium and parking level.

Looking Ahead

Early collaboration between the team members, the variety of structural steel lateral systems and plank-on-steel framing for the residential tower resulted in an economical building that is anticipated to play a big role

in revitalizing the historic East Market commercial district. The project serves as a positive example of a viable new framing scheme for similar projects in Philadelphia. Phase two of the project—a 250,000-sq.-ft, 21-story steel-framed residential tower over a two-story retail podium located at the corner of 12th and Market—began erection in January. ■

Owner/Developer

National Real Estate Development

General Contractor

Tutor Perini Corporation


Architect

BLT Architects, Philadelphia

Structural Engineer

The Harman Group, Philadelphia

Steel Fabricator, Erector and Detailer

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