Neil Wexler, P.E.

STEEL CONSTRUCTION AND TEAM EFFORT PROMOTE AFFORDABLE DESIGN FOR NYC APARTMENT HIGH-RISE

Market-rate housing is driven by costs. Because of the income constraints inherent in renting apartments at market rates, construction costs must be kept within acceptable limits for the project to be viable. In cities such as Manhattan where high-end residential construction is the norm, many developers are not familiar with the variable-cost benefits available from using structural steel to construct residential buildings. A Manhattan apartment building located at 215 E. 23rd Street, scheduled for occupancy this autumn, is testimony to the cost benefits of structural steel, as well as its potential for creative adaptation to meet the special needs of residential construction. The 22-story building contains 74 apartments targeted to market-rate rental or slightly better. The site it occupies is 48′ wide with six-story buildings on each side. The ground floor provides commercial space, and the basement houses mechanical rooms, storage and other building services. The facade is recessed at the seventeenth floor to comply with zoning setback requirements.

(Left) Construction is nearing completion for autumn occupancy of new market-rate apartments at 215 E. 23rd Street in New York City.
(Below) Standard moment connections were used in all directions.
Construction photos by Gaston Dubois & Associates, New Hyde Park, NY.

When owner/contractor Levine Builders, Inc. of Queens, NY, made the initial decision to use steel framing for the project, the first objective for the consulting structural engineer was to maximize the available variable-cost benefits. To make the project work, the challenge facing the designers collectively was to squeeze an extra floor into a vertical site plan constrained by the New York City building code. That meant achieving a 9′ - 2 5/8″ floor-to-floor finished height for a total of 22 residential floors, an especially ambitious undertaking for steel framing, which is commonly perceived to require 12′ from floor to floor.

Structural engineer, Wexler & Associates, and project architect, ADG, Architecture and Design P.C., both based in New York City, met that challenge by working hand-in-hand from project inception. The shallow floor system, designed by Wexler, required an extraordinary degree of coordination in both the structural and architectural layouts.

The structural system for the building consists of a conventional steel frame with metal deck and concrete floors supported on composite steel beams. To minimize the floor sandwich, partitions are aligned with the beams, allowing the ceilings to be pushed to within 6″ of the bottom of the metal deck. With little headroom available, fitting ductwork and cables needed for services required tight control and close coordination with all the trades.

Selected to provide a two-hour fire rating, the floor system consists of 3 1/4″ of lightweight concrete covering metal deck 3″ thick. Total floor thickness of 6 1/4″ is therefore comparable to concrete flat plate construction. The floor system allows a maximum span of 13′, producing room dimensions in the acceptable range for market-rate apartments.

Raising ceilings to the top of the beams also served to maximize architectural ceiling height. Following application of sprayed fireproofing to metal decks, the ceilings were finished with sheet rock, and soffits were cre-

Framing the beams at the partition lines allowed ceilings to be raised close to the bottom of metal decking. Fireproofed decking is now ready for sheet rock, and soffits will be added for an aesthetic finished look.

ated at the beams and girders. Steel framing afforded additional design latitude by virtue of its given advantages over concrete: allowing increased room size by eliminating the need for thick concrete shear walls, steel framing permitted increasing room size, and relatively fewer columns yields more column-free space for greater design flexibility.

Designed entirely for function and cost, other elements of the floor structure include cambered, unshored composite construction, which is more efficient than shored composite beams or bare steel. Furring fastened to the metal deck also contributes to both cost and height savings in the ceiling assembly.

The recess at the seventeenth floor was framed on special 14" deep steel girders. Special seated connections for these heavy girders were welded to the columns.

The lateral-load resisting system consists of spandrel moment frames in both directions. Eighteen different wind and seismic load combinations were considered, and the structure was designed to withstand the most unfavorable combination. To resist uplift, rock anchors were lowered below the footings and embedded into the bedrock (Manhattan Shist) at four locations. Special base plates were designed to connect the anchors through the foundation to the steel columns above. Safety factors of 1.5 or better were designed for uplift and sliding at the building base.

Back to the future for multi-family housing

The structural design for 215 E. 23rd Street takes full advantage of the inherent advantages afforded by steel construction. Its superior efficiency relative to concrete permits the use of smaller transfer girders and reduces total weight, along with lateral and gravity loads, for reduced foundation requirements. The ductility of steel is an added benefit for seismic design. And the use of prefabricated steel offers further opportunities for reducing costs by increasing the pool of suppliers for competitive bidding.

From the 1930s through the 1950s, high-rise apartment buildings were typically built using structural steel. Many hundreds of those buildings in New York City are still in use today. Now, buildings such as 215 E. 23rd Street are matching the floor-height advantage that helped sustain the dominance of concrete construction in the decades that followed the first steel age. As tangible proof that steel is more versatile than ever, the designs for those buildings are sure to change perceptions and open eyes to new possibilities for residential construction.

Neil Wexler, P.E., is President of Wexler & Associates in New York City.

STRUCTURAL ENGINEER:
Wexler & Associates, New York City

ARCHITECT:
ADG, Architecture and Design P.C., New York City

STEEL FABRICATOR:
Namasco, Suwanee, GA (AISC member)

GENERAL CONTRACTOR:
Levine Builders, Douglaston, Queens, NY

SOFTWARE:
RISA 2D

RAM SBeam for designing composite steel members

View of metal deck and fire-protected beams prior to gypsum board installation.