Sporting a NEW LOOK

BY JUSTIN DEN HERDER, P.E.

Exposed steel framing flexes its muscle at a new university sports facility.


Robert Silman Associates

◄ ▼ The five-story, 48,000-sq.-ft Campbell Sports Center uses 325 tons of structural steel in all to achieve shallow floor assemblies and long spans.

▲ ▼ On the interior, many of the steel beams are upset—the plank bears on top of the beam's bottom flanges—to maximize floor-to-floor heights.


Robert Silman Associates


Steven Holl Architects

CAMPBELL SPORTS CENTER is the new face of athletics at Columbia University in Manhattan.

The five-story, 48,000-sq.-ft building, designed by Steven Holl Architects, is the primary athletics facility for all of the school's outdoor sports programs. A combination of strength and conditioning facilities and student-athlete spaces coexist in the state-of-the-art building, serving the minds and bodies of the school's student athletes.

The conceptual design for the building is taken from the phrase "points on the ground, lines in space," which references the diagrams used by sports teams to strategize their plays. In this case, the points are slender, tilted columns where they meet the sloping grade, and the lines are its bracing, terraces and external stairs.

Given the relatively modest budget ($30 million), challenging site topography and a complex geometrical floor plan, structural engineer Robert Silman Associates saw this project as an opportunity to use typical construction materials in creative and ingenious ways. The building is steel-framed, which was dictated by the architectural and programmatic requirements, chiefly the desire for shallow floor assemblies and the need for long spans over vast spaces. It uses 325 tons of structural steel in all.

The building consists of a primary body, which accommodates the strength and conditioning room, offices and a hospitality suite. At the fourth floor, an arm juts out from this main part of the building to the west to form a portal-type structure that's supported at its tip by a combination of the slender, sloping columns (the points on the ground). At the east end of the building, an auditorium constructed of two-story, full-height trusses slopes upward and cantilevers from the fourth-floor framing level, supported on two custom-fabricated plate girders. Another massive 22.5-ton, 54-in.-deep plate girder spans 60 ft over the double-height fitness room. Its presence adds brawn to the space and complements the clanking of the steel weights below.

The superstructure is predominantly made up of 12-in.-deep hollow-core precast plank elements that span up to 40 ft across a series of east-west steel frames. At the building's perimeter, the steel was lowered to allow the planks to span over top of the spandrel beams and cantilever up to 8 ft to form the exterior terraces. On the interior, many of the steel beams are upset—the plank bears on top of the beam's bottom flanges—to maximize floor-to-floor heights. Careful consideration was given to construction sequencing and erection during the layout of these upset members.

Justin Den Herder (denherder@silman.com) is a senior project engineer with Robert Silman Associates.


Robert Silman Associates


Steven Holl Architects


Robert Silman Associates

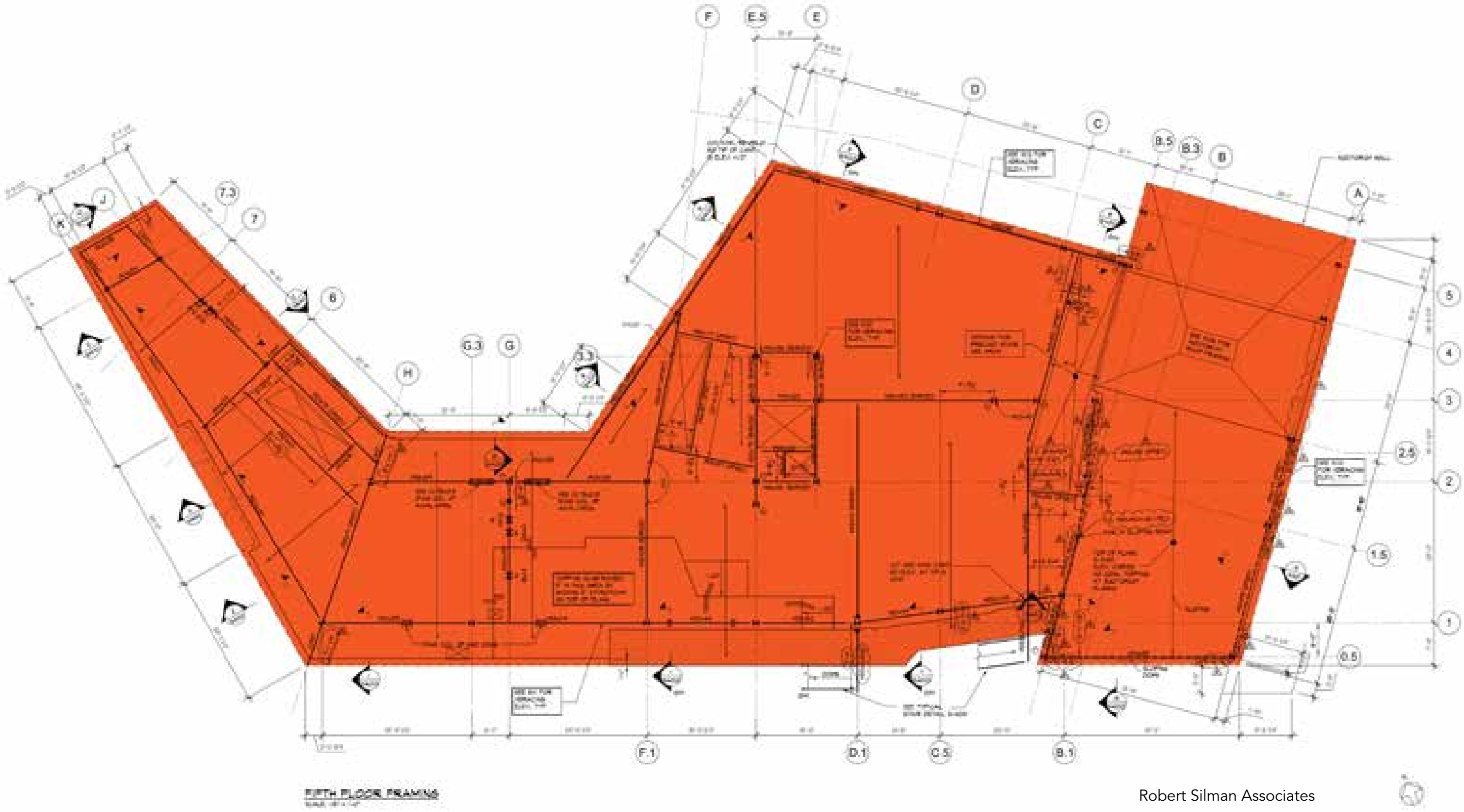
▲ Exterior support.

▼ A site plan of the project.

▲ The building is adjacent to elevated New York City Subway tracks.

▲ One of the building's metal staircases.

Steven Holl Architects



Robert Silman Associates

▲ The framing plan for the fifth floor.

▼ The lateral system is a combination of HSS braced frames and moment frames in the east-west direction and HSS braced frames in the north-south direction.

Robert Silman Associates

Robert Silman Associates

An Array of Vertical Elements

The columns and braced frames were aspects that the design team deliberated extensively, as the design intent was to expose a majority of the framing and integrate it within the language of the building. The columns beneath the tip of the building's elevated arm were studied intensely in a variety of schemes that combined sloping, skewed columns with straight, slender ones. Of the six configurations, the design team chose an elegant and efficient option that orients the columns to run in concert with the natural inclinations of the load paths of the framing above.

The lightness of the arm was made possible by designing a 65-ft-long truss that forms a bridge connecting the arm back to the body of the building, thus maintaining a column-free area below most of the arm.

The lateral system is a combination of HSS braced frames and moment frames in the east-west direction and HSS braced frames in the north-south direction. These bracing elements are exposed, aesthetic features of the building, fulfilling the lines in space motif. Because the braces were always intended to be exposed, their gusset plate profiles were another aspect of the design that was rigorously worked out with the architect. The geometric profiles of the gusset plates were streamlined, thereby minimizing the amount of steel, alleviating conflicts with continuous plank pieces and permitting them to serve as featured architectural elements.


Steven Holl Architects

Chris McVoy, Steven Holl Architects

▲ The close proximity of the elevated subway tracks placed restrictions on the potential locations for crane placement, which influenced the erection sequencing of the framing.

▲ The angular nature of the building is apparent from virtually any point of view.

Intricate Coordination

The close proximity of the elevated subway tracks placed restrictions on the potential locations for crane placement, which in turn influenced the erection sequencing of the framing. As a result, it became necessary to erect the steel at the arm portion of the building first. Silman worked closely with the crane engineer and the shoring engineer to locate temporary steel that would allow for the arm to be self-supporting. Because of the nature of the sloping columns supporting this portion of the building, the overall stability of the arm relied on the mass of the main body of the building.

Since the building's services were to be exposed in much of the structure, the layout of MEP services was critical. This resulted in numerous web penetrations through the beams, which required a concerted, coordinated effort from the design team to determine duct routing in an efficient and effective layout. In locations where penetrations were not feasible, steel was upset into the planking to avoid web penetrations altogether. Networks of conduits run through the 3-in. topping slab above the precast plank. Where these conduits conflicted with top flanges of the steel framing, a plate-reinforcing detail was developed.

By producing framing elevations that provided the anticipated dead, superimposed dead and live load deflections of the spandrel beams, it allowed the contractor to build these tolerances into the design and installation of the curtain wall elements. Further breakdowns of the dead load deflections were calculated to mimic the exact site conditions at any given instance throughout the curtain wall installation.

The design of the building proved that with careful consideration of construction sequencing, wonderful moments of architecture can be achieved—in a budget-conscious manner—with the simple materials that are used every day. Rigorous global analysis coupled with an in-depth study of each individual gusset plate and moment connection accounted for the design of the steel-framed skeleton, whose size and scale blends seamlessly with the architecture. ■

Owner
Columbia University

General Contractor
Structuretone/Pavarini McGovern

Architect
Steven Holl Architects

Structural Engineer
Robert Silman Associates