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The Mark's Steel Knuckles

Designed by ZGF Architects with Arup, the striking 48-story tower in Seattle features an innovative diagonal mega-brace system.

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Connie Zhou/OTTO

Between Amazon's expanding vertical campus and the in-progress replacement of the Alaskan Way Viaduct with a promising waterfront park, Seattle continues to undergo a rapid transformation. Among downtown's newest jewels is the Mark, a 48-story hotel and office tower designed by the local office of ZGF Architects that rises from a quadrant of a city block.

The 750,000-square-foot faceted structure rises between two centenarian neighbors, the Beaux-Arts sanctuary of the First United Methodist Church and the Jacobean-style Rainier Club, cantilevering over the former by up to 20 feet.

As a part of the project—developed by Kevin Daniels, president of Daniels Real Estate and a member of the National Trust for Historic Preservation board of trustees—the sanctuary was restored for use as an event space.
Constrained to a footprint of just 15,000 square feet, the tower's floor plates had to be extended to achieve the desired square footage. Daniels also tasked ZGF with creating an iconic structure to reflect Seattle's aspirational spirit.

ZGF used paper models and the classic proportions of the human anatomy to explore dozens of designs that satisfied the constraints. Early concepts featured more "rudimentary" cantilevers or "heavier, more geometric" forms, says ZGF partner Allyn Stellmacher, AIA.

Connie Zhou/OTTO

"Ultimately, we came back to a disposition of the parts of the building in a way that we thought was more artful, but that also was melded with a more effective [line] for the bracing."

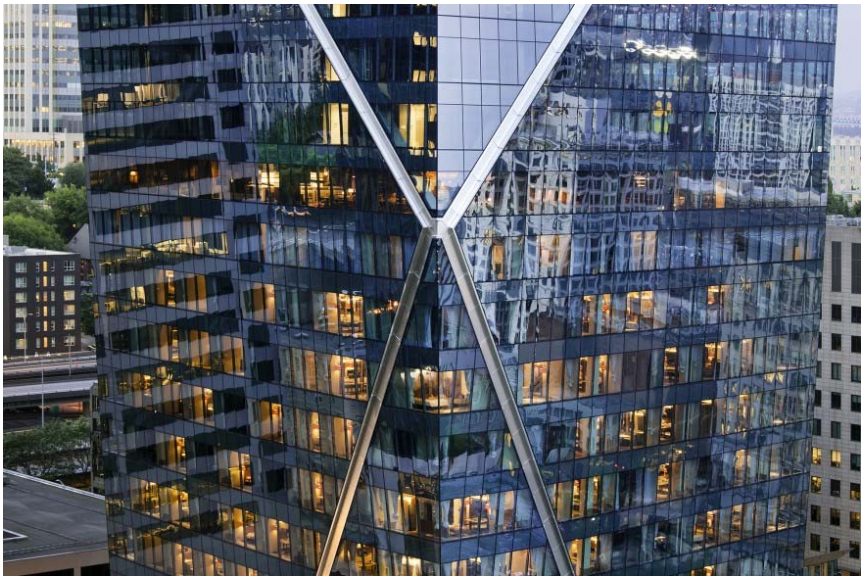
The final form is an asymmetrical obelisk, with exposed diagonal steel braces that zigzag up each elevation, emphasizing the tower's verticality.

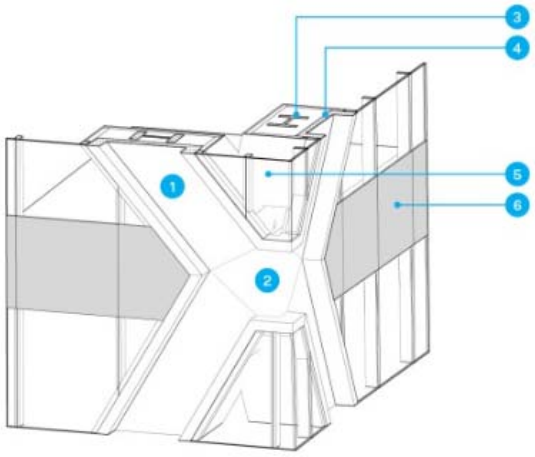
The architects used the long, clean lines of the steel members to differentiate each facet of the façade, whose subtle shifts are enhanced by the reflective glazing. Unlike some exoskeletons, the bracing's stainless-steel cladding recedes 11 inches into the Mark, as if the zigzags are etched into its skin.

The diagonal mega-brace system—among the first of its kind in a seismic zone—derives from ZGF's close collaboration with Arup, the project's structural engineer. The tower structure consists of a central concrete core with steel-framed, concrete-infilled floor plates supported by beams spanning up to 50 feet, and four steel columns slightly inset from each building corner on each elevation, leaving the interiors and the corners of the tower column-free.

The perimeter bracing system "acts like a closed tube that engages the axial stiffness and strength of the perimeter steel columns," according to text supplied by Arup. As a result, it

transfers wind and seismic load requirements from the concrete core to the building perimeter, where the diagonal members transfer the loads to the columns. Arup estimates this system uses 10 percent, or 750 tons, less steel than alternative designs.
The 200- to 325-foot-long diagonal braces (inboard of the cladding) consist of approximately 30-





1. Stainless steel brace cover with linen finish, 3' wide with 11" inset
2. Custom steel knuckle with full penetration weld to four brace members and three floor beams (beyond)
3. Steel wide flange brace with a maximum 2' depth and approximately 4"-thick flanges; encased in spray-on fireproofing
4. Rigid insulation
5. Vision glazing
6. Spandrel glazing

foot-long wide flange beams with a depth of 2 feet and flange thickness exceeding 4 inches. At building corners, the X-shaped intersections created where the diagonal braces meet—dubbed “knuckles” by the design team—were among the hardest to detail.

Each shop-fabricated knuckle is uniquely made to accommodate the various incoming angles of the four intersecting diagonal braces, in addition to three floor beams. The brace members were

initially bolted to the knuckle during fit up and erection, and then all connections were made permanent via full penetration welds.

Each incoming diagonal member is also fixed to the nearest vertical steel column above and below the building corner at which the intersection occurs, creating a “small, triangulated connection that helps reinforce the load transfers as those diagonals come down the building and hit a corner, and then strike down again to another corner,” he explains. At the building’s base, the braces anchor into five-story-tall, 3-foot-square steel box columns, custom-fabricated for the project.

Steel fabricator Supreme Steel (formerly Canron Western Constructors) in Portland, Ore., produced the steel knuckles. Several curtainwall portions, as well as the bracing’s stainless steel cladding—a glazed, insulated, and unitized panel attached via Halfen anchors—had to be similarly customized. “At the end of the day, it fit really well,” Stellmacher says. “A few pieces had to be reworked a little bit, but overall it was very clean.”

Stellmacher credits the project’s success to the in-depth conversations held with the engineers, the fabricators, and the contractor during the pre-construction phase, and their continued collaboration. “The notion that it’s difficult to build a building like this—well, it just depends on where your heart is,” he says. “The modern tools and trades came together to make the building happen.”